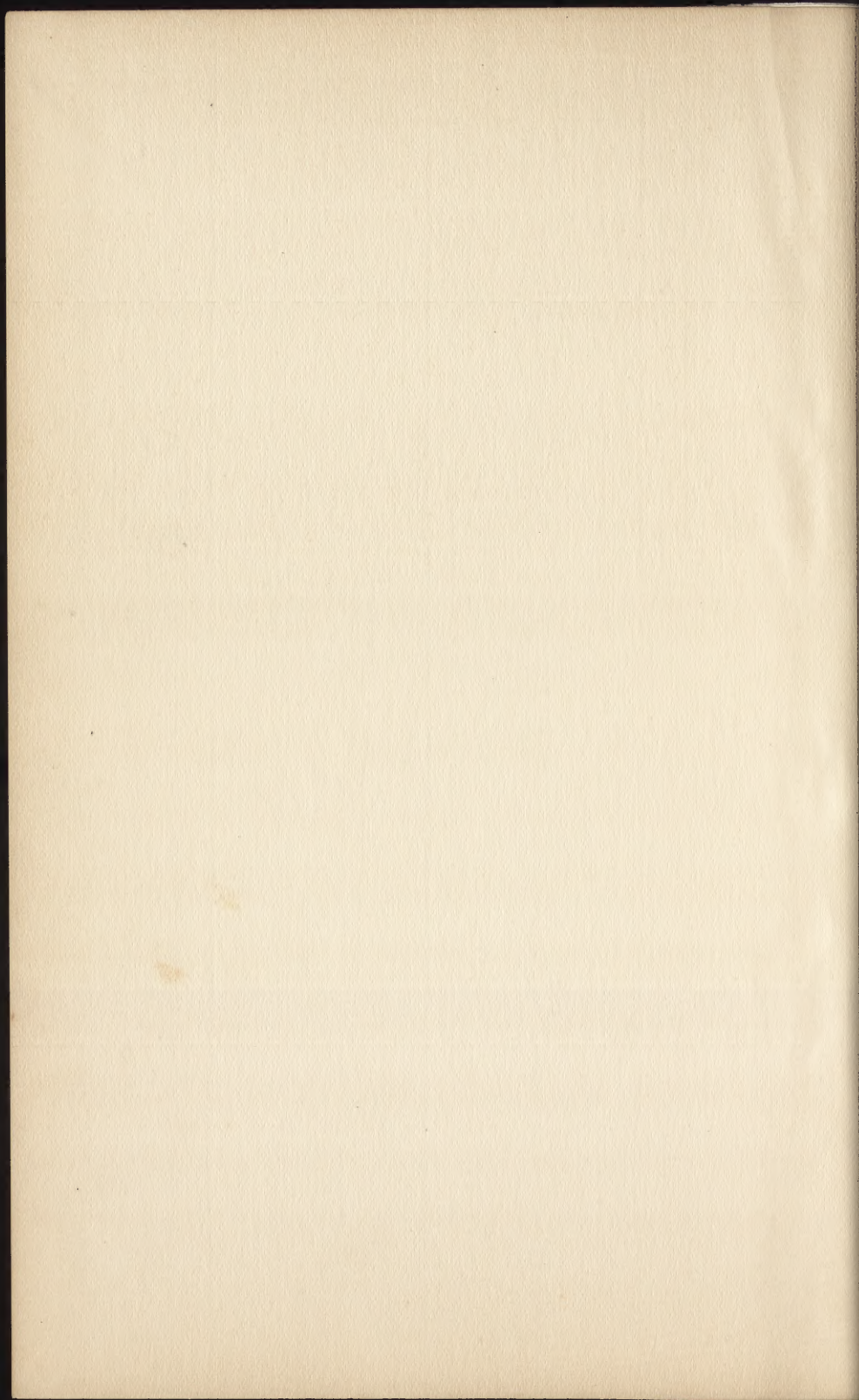






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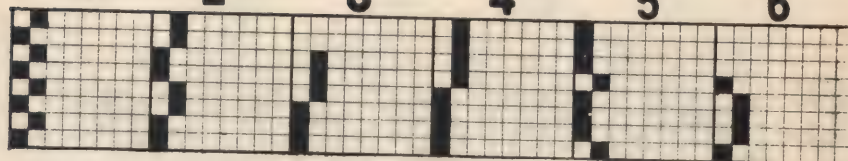
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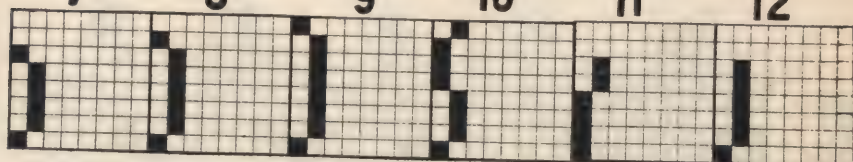
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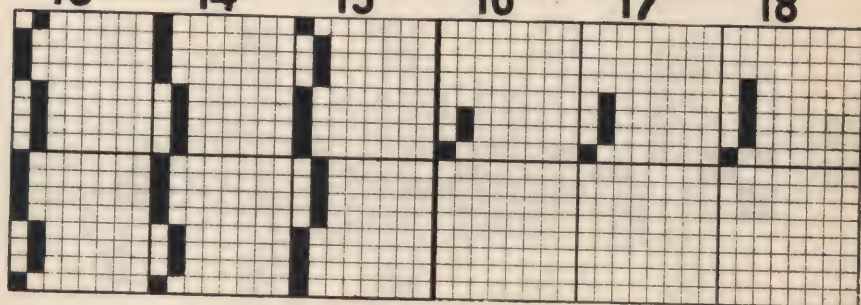
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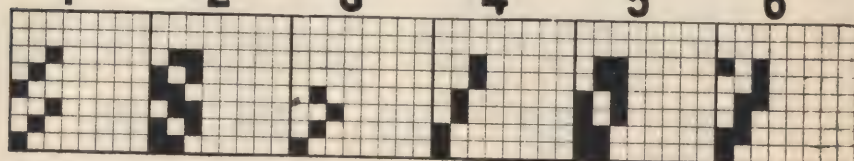
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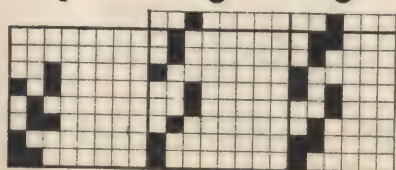
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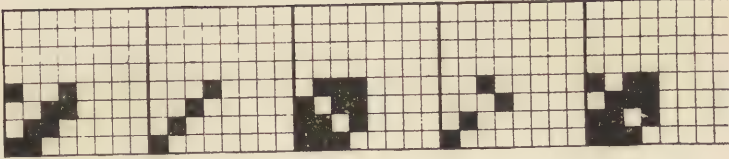
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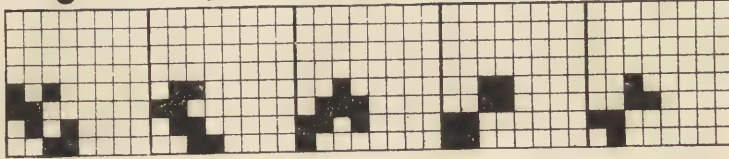
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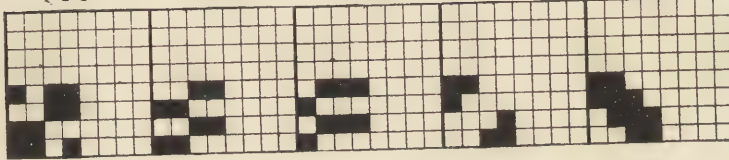
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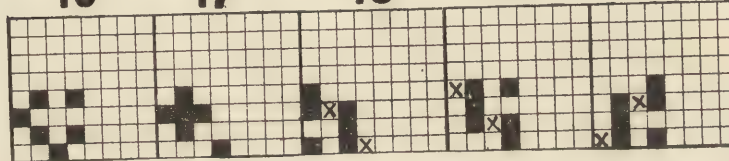
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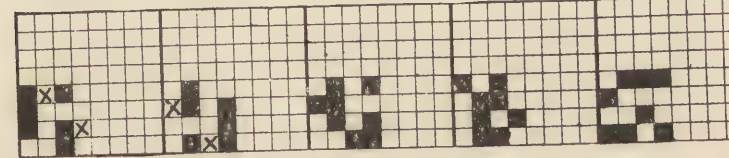
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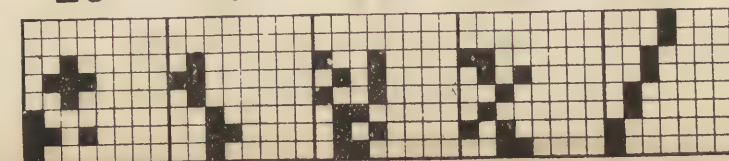
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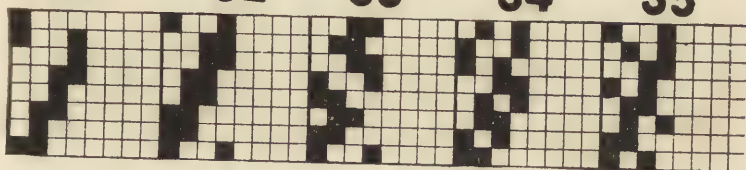
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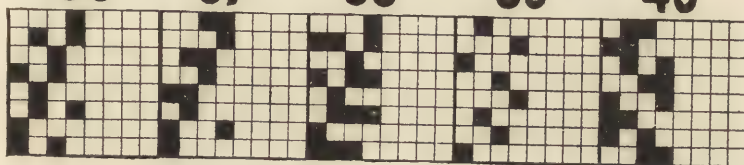
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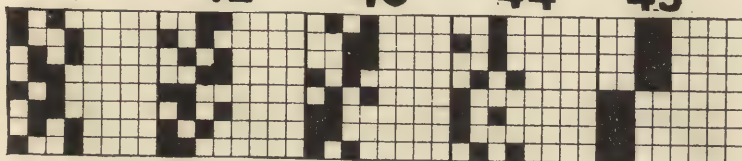
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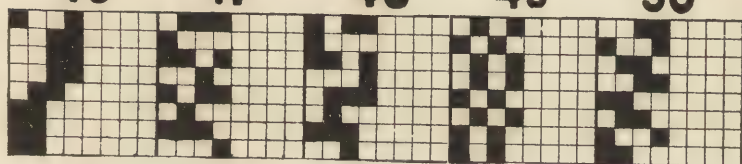
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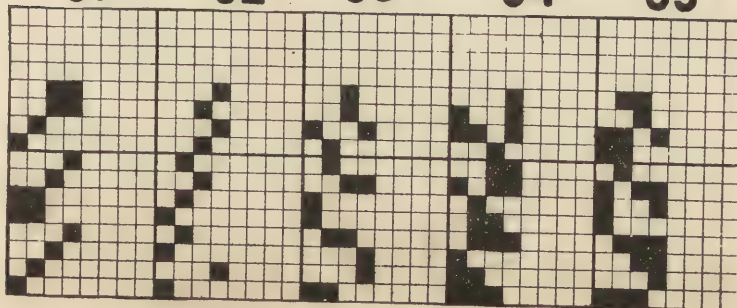
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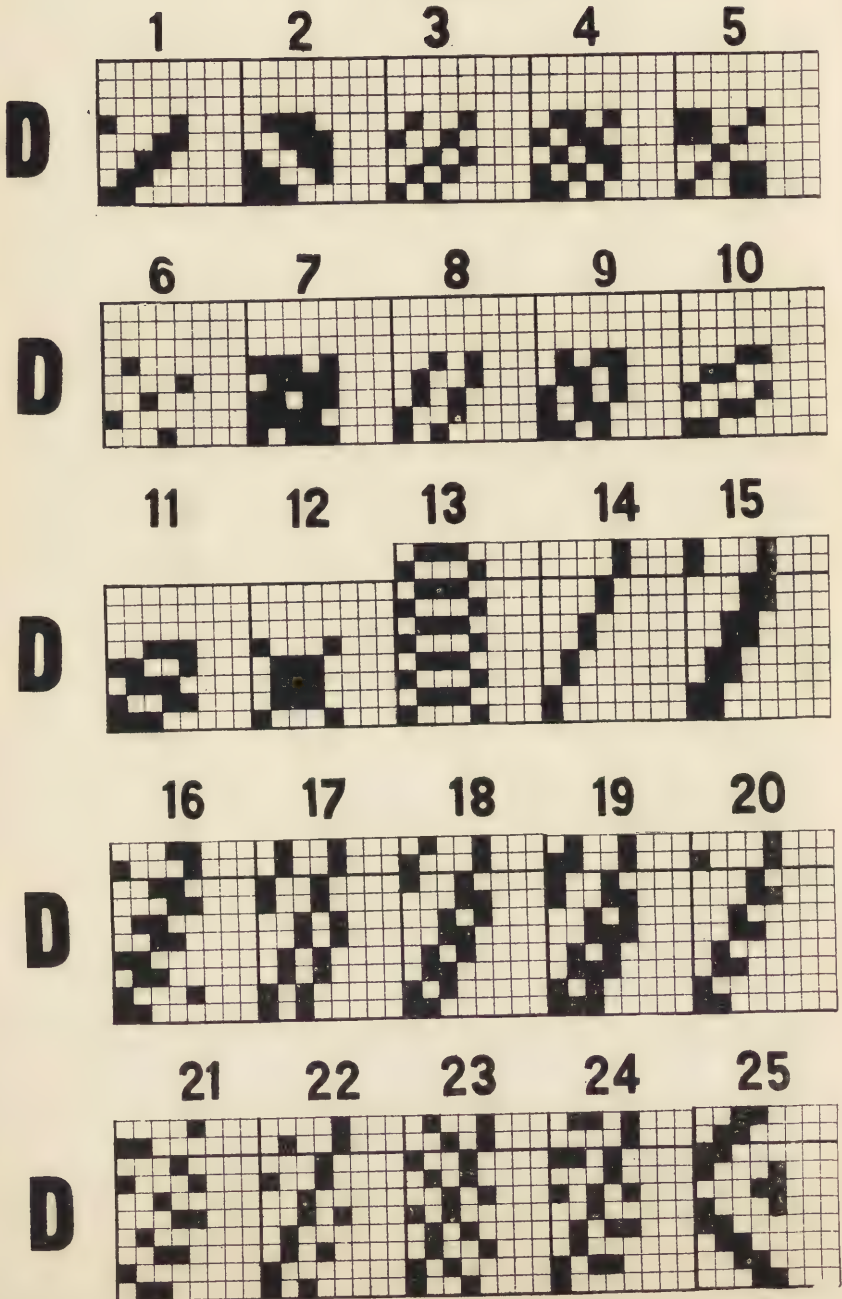
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DESIGNING.



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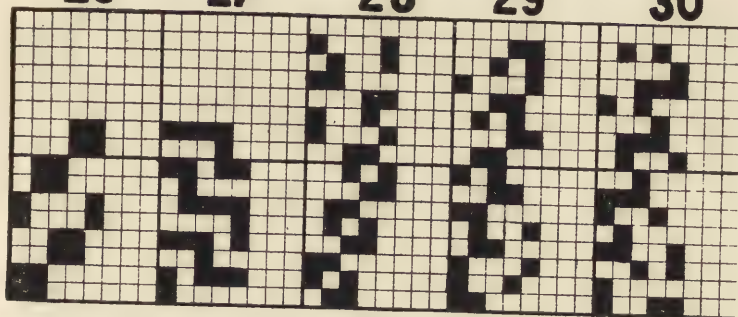
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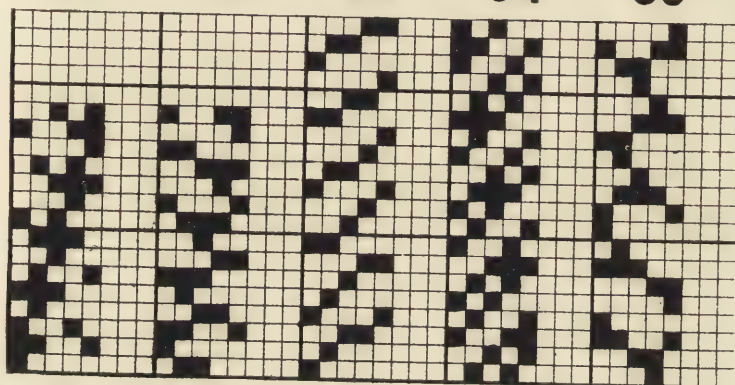
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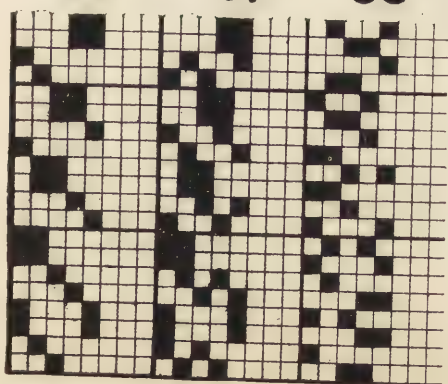
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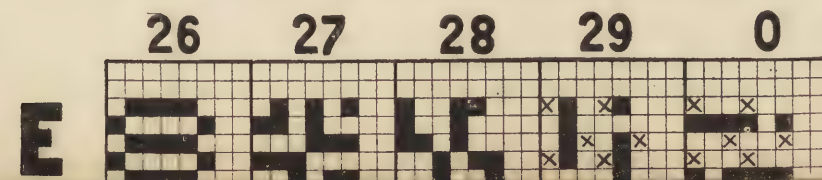
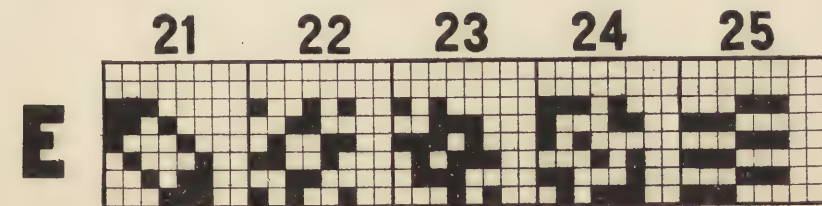
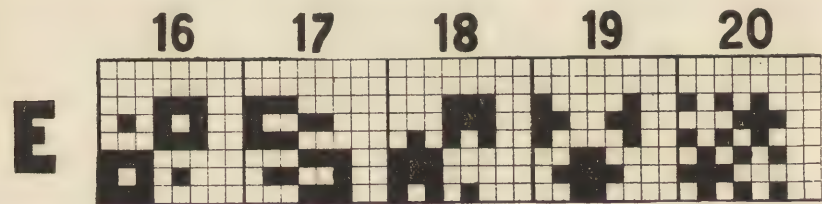
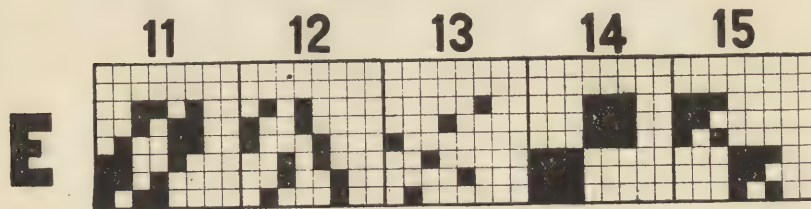
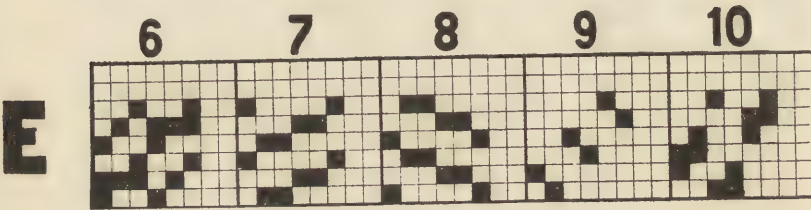
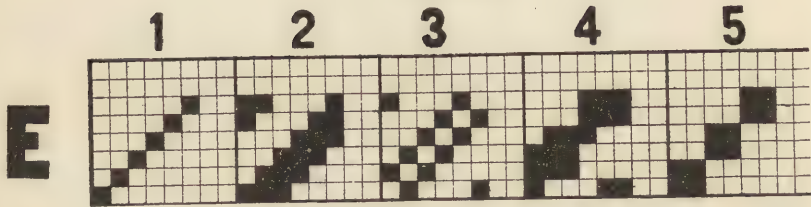
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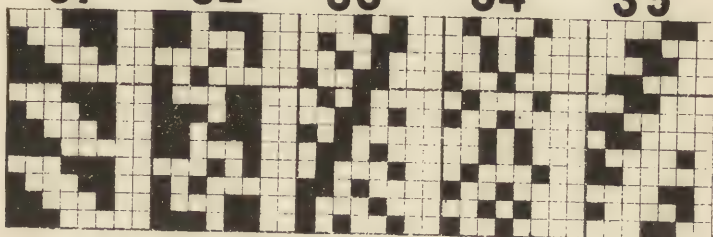
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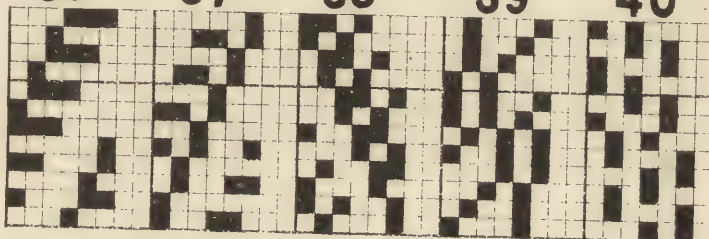
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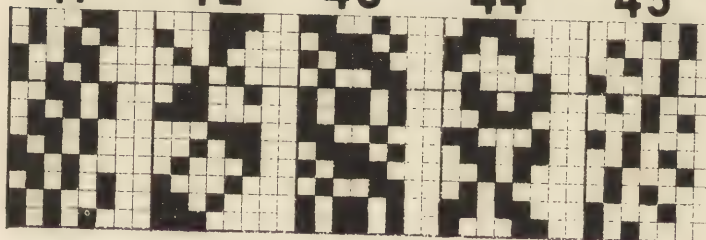
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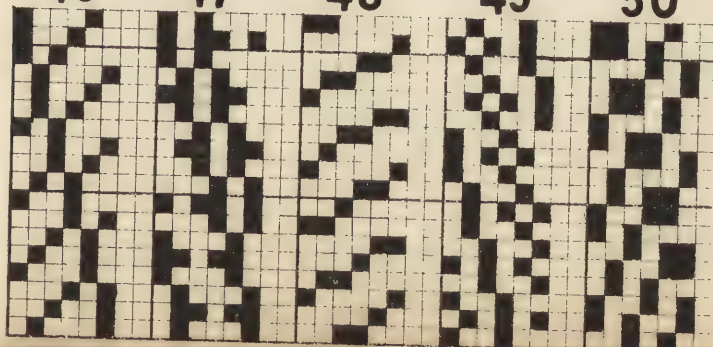
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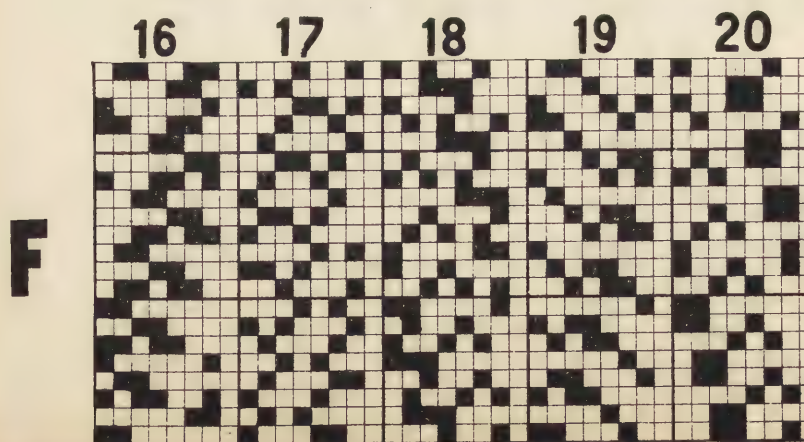
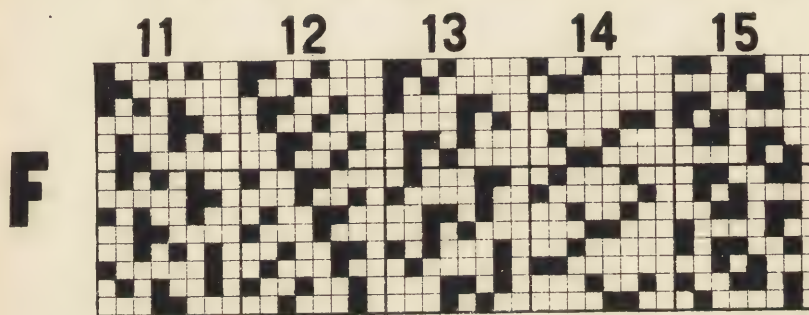
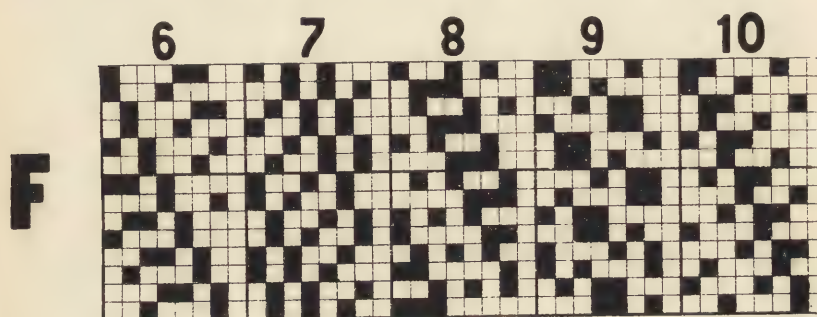
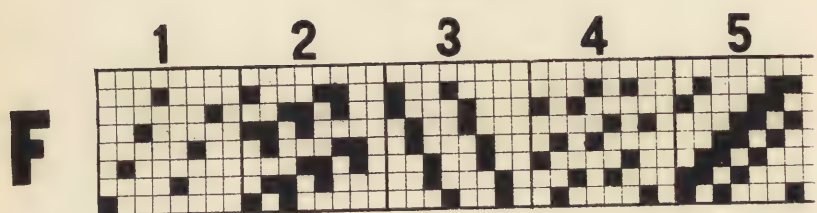


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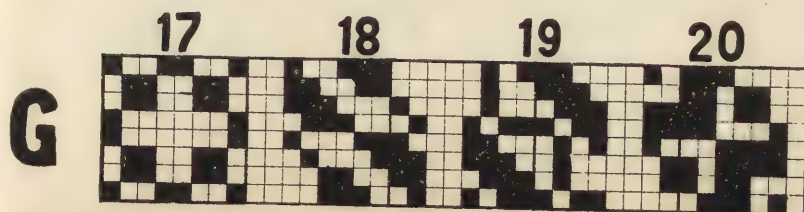
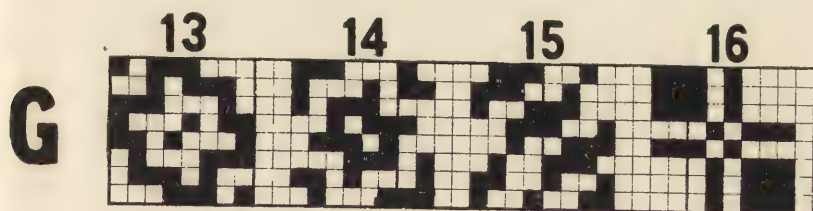
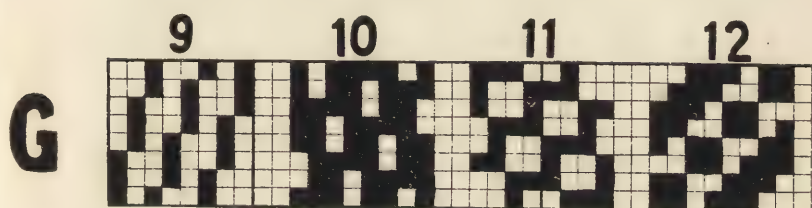
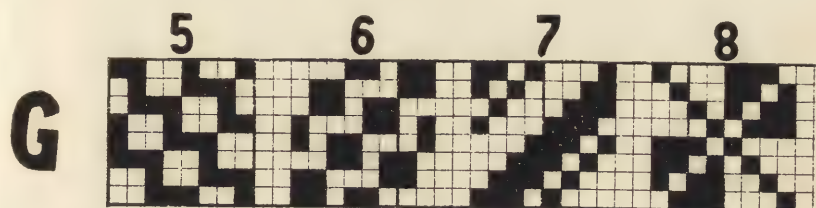
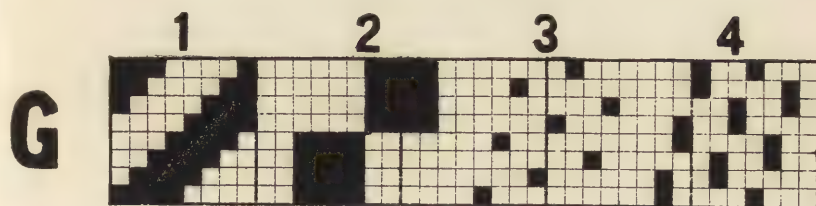
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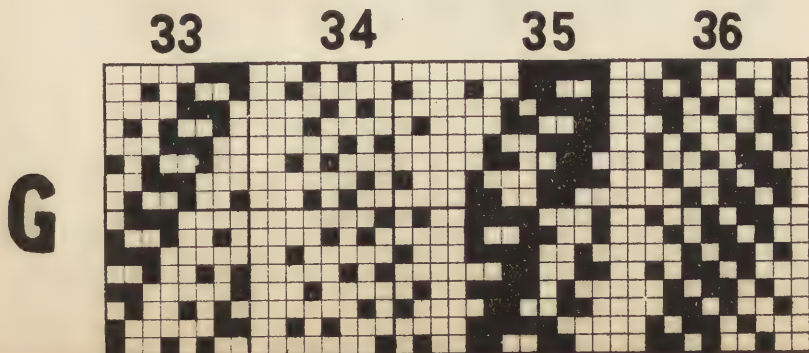
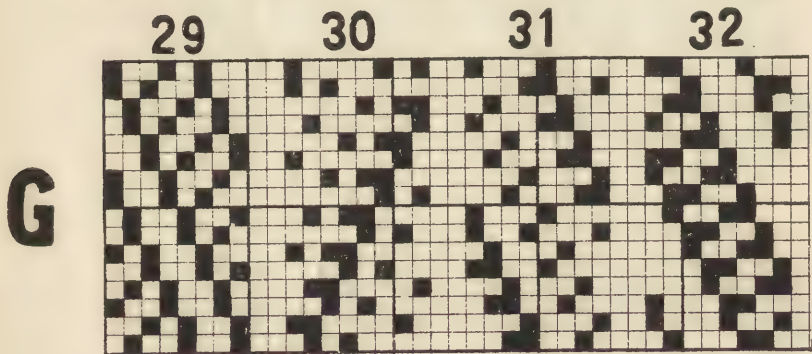
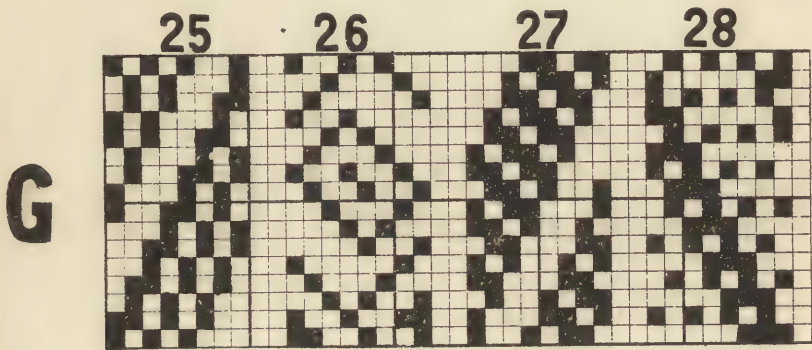
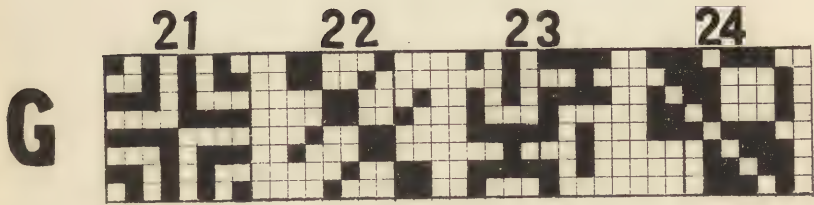
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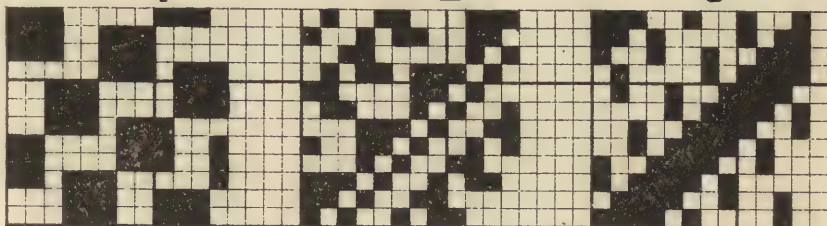


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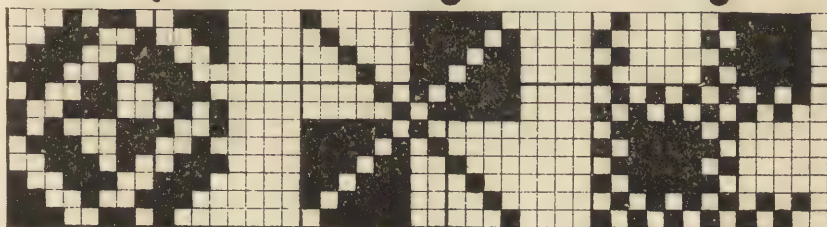
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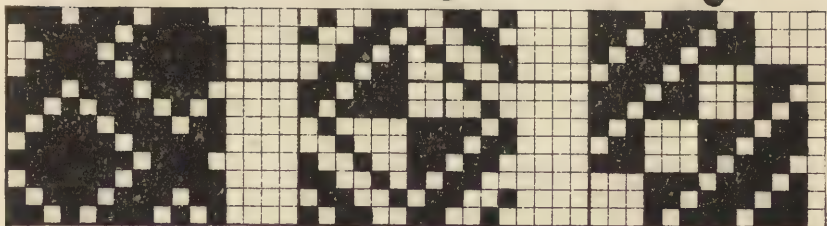
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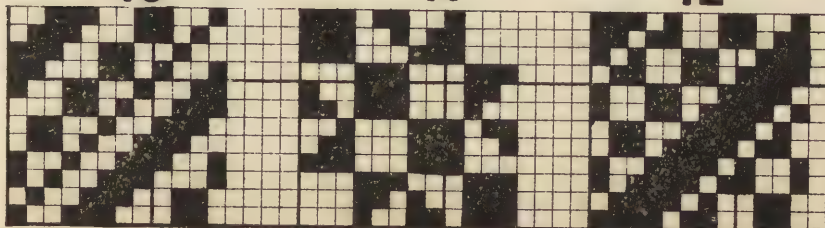
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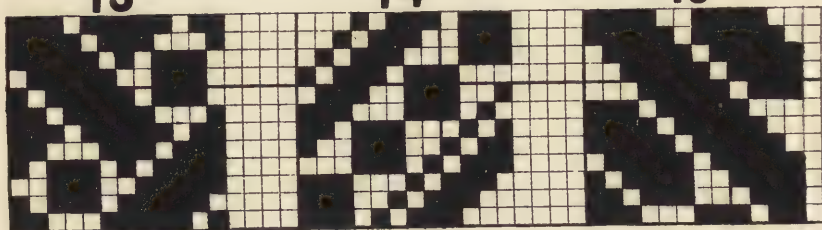


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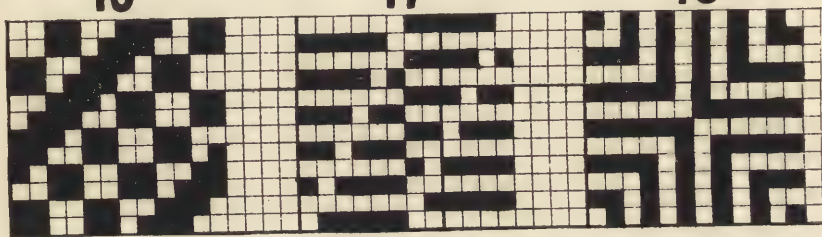
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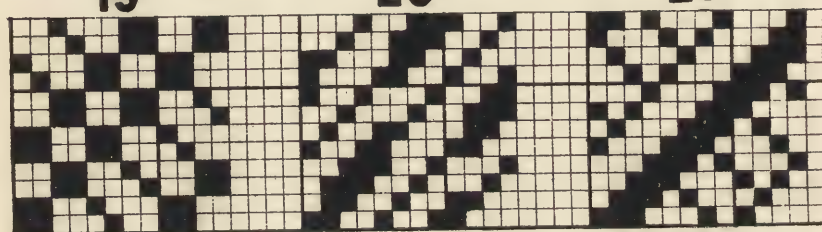
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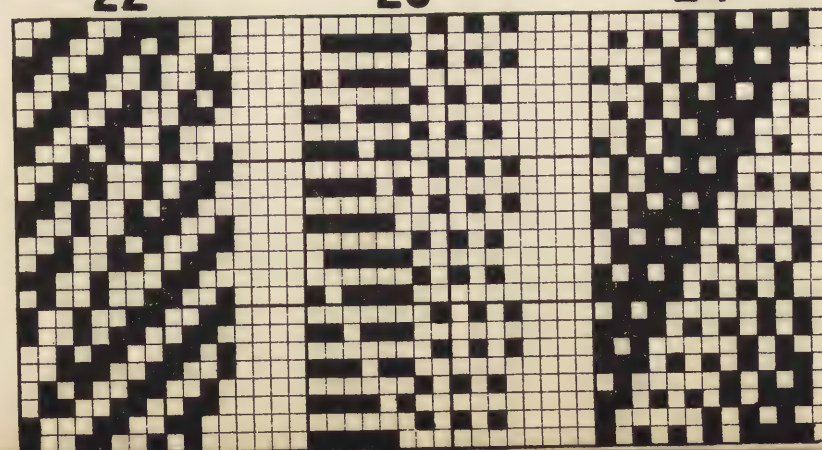
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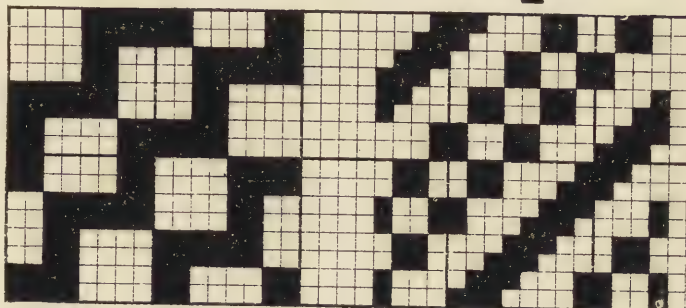


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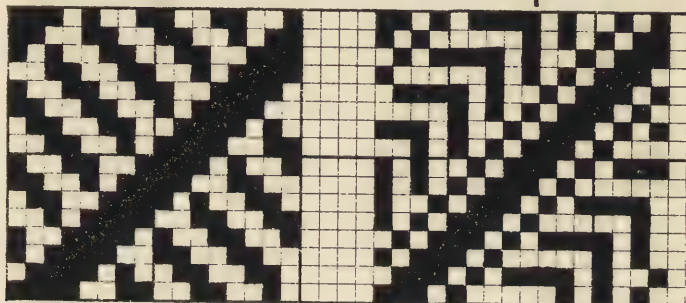
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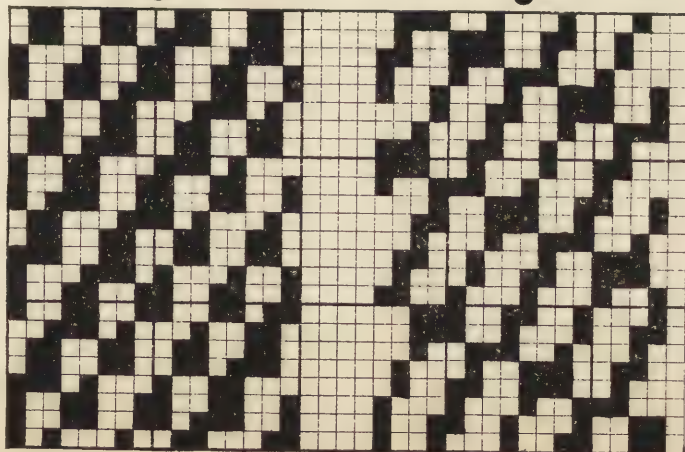
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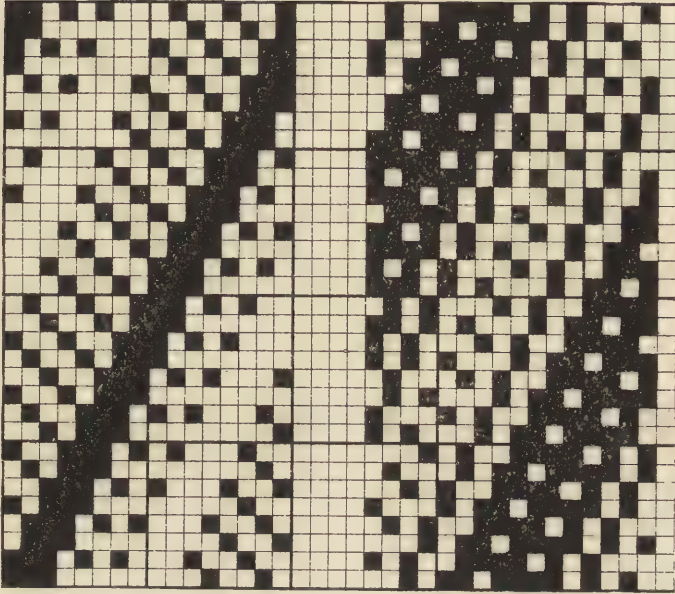


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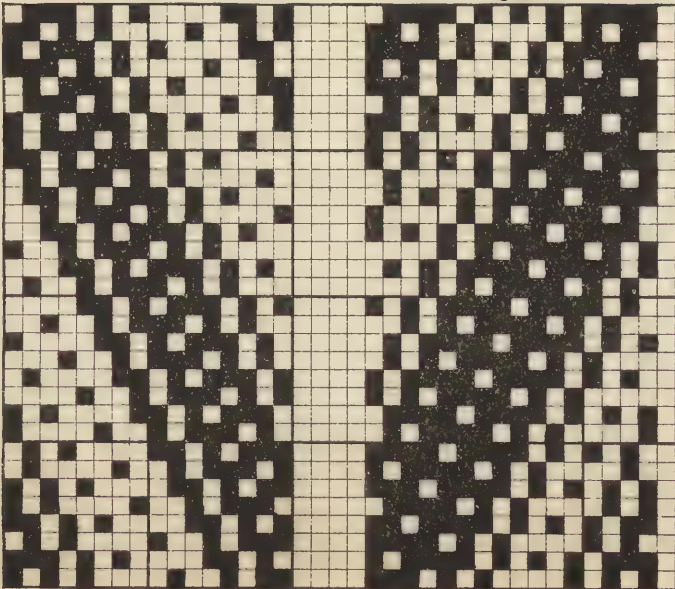
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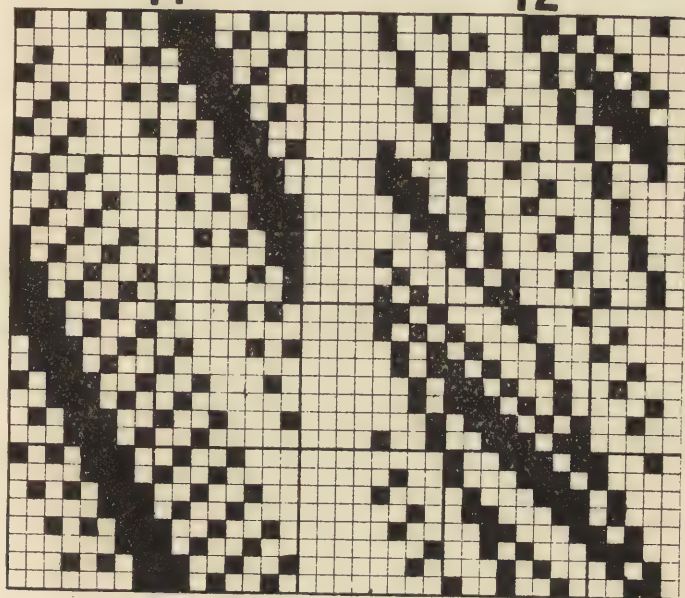


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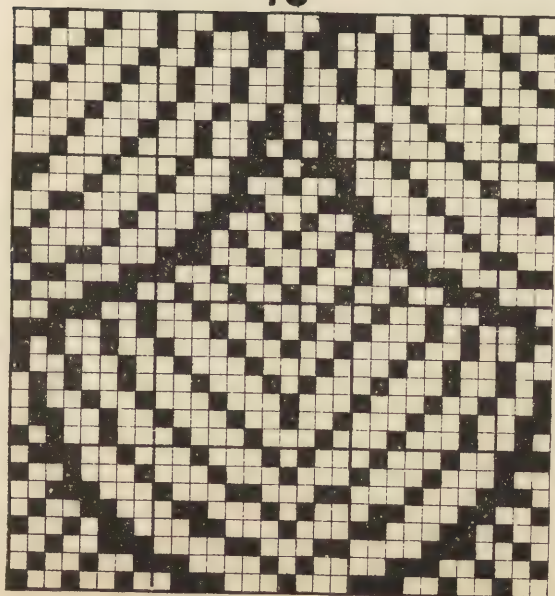
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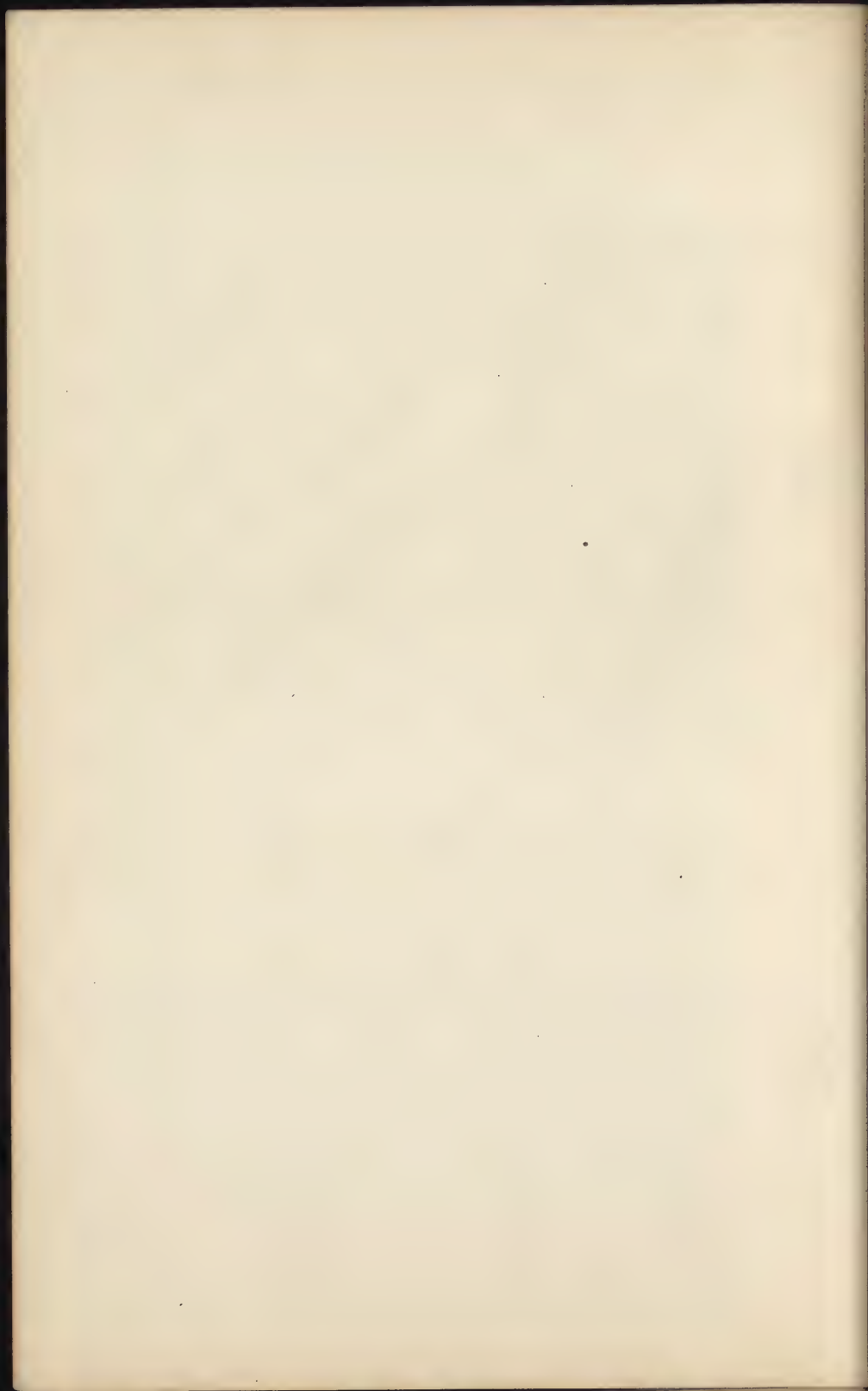
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DESIGNING.

1. In order that one may intelligently understand the best methods of manufacturing any class of goods, it is first of all essential to acquire a thorough knowledge of woven fabrics, since, if the results obtained, or in other words the finished products, are not understood, it is unreasonable to suppose that the *reasons* for the processes through which the yarns pass before becoming cloth, can be intelligently comprehended.

2. The person who can take a small sample of cloth and reproduce it in the loom, or who can originate some special design, having only the necessary yarns and mechanism to work with, even if this work is not in his direct line, has a great advantage over the one who is without the knowledge necessary to perform this work.

3. Designing may be said to be as old as weaving, since no cloth can be produced unless the manner in which the ends are drawn through the harnesses, the order of raising the harnesses and the order of interlacing these ends with the filling, are known.

4. At the same time it may safely be stated that no branch of textile manufacturing exemplifies the statement, "nothing new under the sun," so fully as does that of designing, for while each season brings out what are apparently new and original designs, yet if these are carefully studied they will mostly be found to be simply modifications or combinations of those which have previously been seen.

5. Cloth analysis, and the reproduction of cloth which will be similar to a small sample, and designing, are studies which are closely allied, and it cannot be too strongly impressed

upon the student of designing that taking advantage of every opportunity to study the structure of any cloth that may come under his notice will be of the greatest assistance to him.

6. It will be the object of these lessons to teach the student the principles which underlie all woven fabrics, explaining and illustrating the methods adopted when determining the different items that are always necessary, in order to produce cloth from yarns, and pointing out the defects of certain systems and the advantages of others.

7. With this instruction paper the student will receive a sample of cloth marked A, to which reference will frequently be made when defining the different terms that are to be met with in designing.

The sample A is what is known as *plain* cloth, and its construction is the simplest of the many that are used for the production of woven fabrics.

8. Although mention has been made in previous lessons of warp and filling, it will not be out of place to again define these terms.

All woven fabrics are made from two systems of threads, which are known as warp and filling, the warp being those threads which run lengthways of the cloth, while the filling runs from side to side.

9. Thus in the cloth sample A, the threads running from top to bottom of the cloth are known as the warp **ends**, while those threads running from side to side are the **picks** of filling.

The word end is frequently used for the warp yarn, while the word pick is used for filling.

10. If the student examines this cloth closely, it will be noticed that a pick of filling is *over* one end, *under* the next, *over* the next, and continues in this manner throughout the sample. It is by means of this crossing of the ends and picks, or **interlacing** of warp and filling, as it is known, that the cloth is formed.

11. The manner in which the warp threads are drawn through harnesses, which raise and lower them, thus forming an opening, known as a shed, through which the filling passes, has been explained in a previous lesson, and consequently it will be assumed that the student understands this subject.

12. It should be understood that the interlacing of the warp and filling, just referred to, is not the same in all cloths; in fact it is by changing the manner of this interlacing that different effects are formed. Consequently when a certain interlacing is to be employed there must be some means of showing the manner in which the warp ends and the filling picks are to cross each other.

It is for this purpose, namely, to show the interlacing of the warp and filling, that **design paper** is used.

13. Fig. 1 shows several different styles of design paper. A is the kind most generally used, and this will be the one referred to at present. By examining this closely it will be noticed that heavy lines divide off small squares, there being eight lines of these squares each way.

14. Each *row of squares* that runs from the top to the bottom of the paper represents a *warp end*, and each *row of squares* that runs from side to side represents one *pick of filling*.

In connection with this explanation the student should thoroughly understand that it is not the lines, but the *rows of squares which these lines enclose*, that represent the ends and picks.

15. Thus, in A, Fig. 1, there would be 8 ends and 8 picks represented in each part marked off by the heavy lines, and this is the method of designating different design paper, that is, *by giving the number of ends and picks that are shown in the square marked off by the heavy lines*.

16. But the student should carefully note that, in speaking of design paper, the number of ends represented is always given *first*, followed by the number of picks represented.

Thus, A would be called 8×8 design paper, B is 8×12 , C is 18×4 , D is 8×16 , E is 6×24 , and F is 8×8 . In every case the number showing the number of rows of squares for the ends is given first.

17. All of the styles of design paper shown in Fig. 1 have some special advantage, and will be dealt with more fully later, but at present only that class of design paper as shown at A, which is the most common, will be considered.

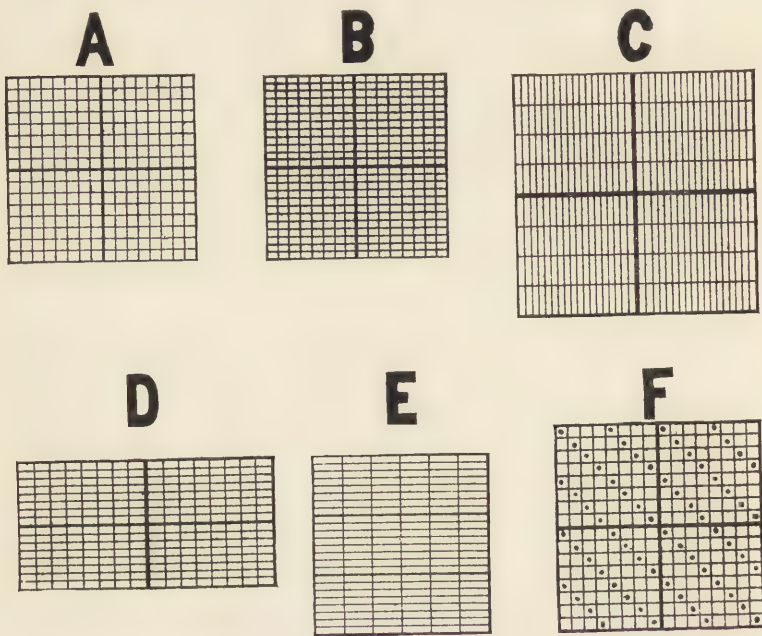


Fig. 1.

18. It has been stated that design paper is used to show the manner in which the warp and filling interlace, and it has also been shown that each vertical row represents a warp end, and that each horizontal row represents a pick of filling.

19. It now remains to show how the interlacing is indicated on the design paper. This is accomplished by *filling in certain of the squares with ink or pencil, while others are left*

blank. Instead of filling in the squares, dots or crosses are often used, and when these are seen it should always be understood that the square is filled.

20. When a square is filled in, it indicates that the warp end, in that vertical row, is *lifted* at that point, and that the pick of filling in that horizontal row is *underneath* the warp end at that point.

21. When a square is left blank, it indicates that the warp end, in that vertical row, is *lowered at that point*, and that the pick of filling, in that horizontal row, is *over* the warp end at that point.

22. These two last statements explain the principal features in representing the interlacing of the warp and filling, and the student should fix them firmly in his mind. *Filled in squares always mean warp up. Blank squares always mean filling up.*

23. This naturally leads to another consideration, namely, the lifting and lowering of the harnesses. It will be remembered that it was stated that the warp ends are drawn through harnesses, and that when a harness is *raised* the warp ends, which are drawn through that harness, are *over* the filling, whereas when a harness is *lowered* the warp ends drawn through that harness are *under* the filling.

24. Consequently whenever a blank is filled in on design paper, which shows that that warp end is lifted, it must of course show that the harness through which that end is drawn is also lifted. On the other hand, when a square is left blank, which shows that that warp end is lowered, it shows that the harness through which that end is drawn is also lowered.

25. The representation on design paper of the interlacing of the warp and filling is known as the **weave**, and in order to give the student a thorough understanding of the method employed, it will be illustrated from the cloth sample A.

26. Fig. 2 will serve to show the structure of the cloth and also the method of representing it on design paper. Dealing first with A and B only, A shows the way the ends and

picks of the cloth sample would look if they were enlarged to that size; and if the student will examine the sample closely, it will readily be seen that this is a correct representation, since the filling is over one end, under the next, over the next, and so on.

27. Referring now to B, the filled in squares and blanks show the interlacing of the warp and filling, or in other words, B shows the *weave*.

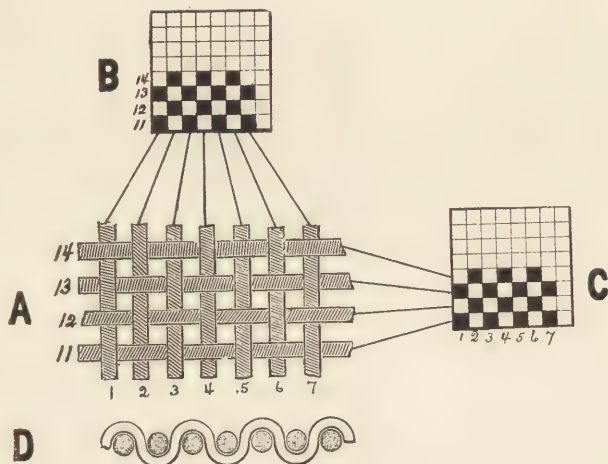


Fig. 2.

28. The student must constantly bear in mind that each row of squares, up and down, represents a warp end, while each row from side to side represents a pick of filling.

29. The lines drawn from A to B show which warp end each vertical row of squares represents. The ends are numbered 1, 2, 3, 4, 5, 6 and 7 at the bottom. These alone will be dealt with first.

30. Taking the ends and following them to B, it will be seen that when the ends are *up*, as shown in A, the corresponding squares in B are *filled in*, and on the other hand, when the ends are *down* the corresponding squares in B are *left blank*.

31. Following the first end, it will be noticed that starting at the bottom of A, this end is *over* the first pick (marked 11), therefore the first square at the bottom of the row of squares representing this end, as shown in B, is *filled in*. Following this same end right up in A, it will be seen that it is *under* the next pick (marked 12), therefore in B, the next square *above* the one previously marked will be left blank.

32. Still continuing with this same end, it will be seen that it is *over* the next pick (marked 13), therefore the next square above, in B, is *filled in*. The end now passes *under* the next pick (14), in A, and this is shown by leaving the corresponding square in B *blank*.

33. Following the next end, or number 2, in the same manner, it will be seen that it is *under* the 11th pick, *over* the next, *under* the 13th and *over* the next. If the vertical row of squares in B, which represent this end, is now examined, it will be seen that wherever this end is *up* the square is *filled in*, and wherever it is *down* the square is *left blank*. B shows the *weave* of sample A.

34. If the student follows each end in the same manner, it will be seen that the interlacing of each end in A is correctly shown in B.

35. It should now be noticed that when the interlacings of the warp ends are shown in this manner, it must necessarily also *show the interlacings of the filling*, since when a square is filled in, it not only shows that the warp end is up, at that point, but it also shows that the filling, at that point, is under the warp, and when a square is left blank, it not only shows that the warp end is down at that point, but it also shows that the filling is over the warp end at that point.

36. Therefore, when the ends have been shown on design paper, the *picks have also been shown*, and consequently B shows when the picks are up and when down, in the same manner as it shows when the ends are up and when down.

37. That this is so may be readily seen by referring to C, which is exactly the same as B, except that in this case the lines are drawn from each pick in A to the row of squares in C, which represent the respective picks.

38. If the student follows the picks from A to C in the same manner that the ends were followed from A to B, it will readily be seen that C shows the interlacings of the picks. Therefore, since B is the same as C, either one of these would show the weave of the cloth equally well.

39. D, in Fig. 2, is another method of showing the interlacing of the warp and filling, and represents the manner in which either the 12th or 14th picks interlace with the warp ends, the curved line being the pick of filling. As plainly shown here, the pick is first over and then under the warp ends.

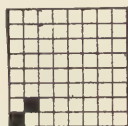


Fig. 3.

40. One other very important point should be noticed in this connection, namely, that *every other end is alike, and every other pick is alike*. By noticing any of the illustrations in Fig. 2, it will be seen that the 1st, 3d, 5th and 7th ends are alike, and also the ends marked 2, 4, and 6, are similar. Noticing the picks, it will be seen that the 11th and 13th are alike, and also the 12th and 14th.

41. From this it will be seen that, in this case of a plain cloth sample, it only requires *two ends* and *two picks* to show the manner in which all the ends and picks interlace. Or, in other words, 2 ends and 2 picks show **one repeat** of the weave, all the other ends and picks being simply repetitions of these two ends and two picks. Fig. 3 shows one repeat of the weave.

42. All weaves repeat on a certain number of ends and picks. It may not necessarily be 2, or 16, or 40, but they must have some limit. Again, the ends may not repeat on the same number as do the picks, but this does not alter the fact that each must repeat at some time.

43. To illustrate this point further, Fig. 4 is given here. B shows the manner in which the ends and picks interlace, A shows the weave on design paper, while C shows simply one of the picks interlacing with the warp ends. If the student follows each end from A to B, it will be readily seen that A is the weave of B.

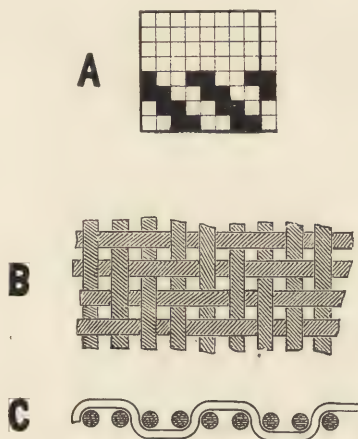


Fig. 4.

44. It should be stated here that when speaking of the *first end*, the one at the *extreme left* is always intended, while the *first pick* is the one at the *bottom*; thus, the *first end* and *first pick* would be represented, in all cases, by the square in the *lower left hand corner*.

45. Referring now to A, notice carefully the interlacings of each end. It will be seen that the 1st, 2d, 3d, and 4th are all different, but next it will be noticed that the 5th is like the 1st, the 6th is like the 2d, the 7th is like the 3d, the 8th is like the

4th, and the 9th is like the 1st and 5th. If more ends were shown they would repeat in this same manner, therefore it will be seen that this weave is *complete on four ends*.

46. If more picks were shown it would be seen that the 5th pick is like the 1st, and so on, therefore the weave is *complete on four picks*. Consequently it will be seen that one repeat of this weave occupies 4 ends and 4 picks.

47. With every new weave that is given, the student should note carefully the number of ends and picks that are occupied in one repeat, and thus become accustomed to determining the repeat of the weave.

48. Suppose that there are 1800 ends in the cloth from which sample A is taken, then it will clearly be seen that there must be some arrangement, by means of which each of these 1800 ends will rise and fall at the proper time. This is accomplished by means of the harnesses in the loom, and the plan which shows the manner of drawing the ends into the harnesses is known as the **harness draft**, also sometimes called the **drawing-in draft**.

49. It may be stated here, and the student should thoroughly understand this point, that *every end in the warp that works differently from the others must be drawn through a separate harness, but every end in the warp that works in a manner similar to some other end may be drawn through the same harness as that other end, providing it is drawn in its regular order*.

50. Thus in the case of the cloth sample A, if every even numbered end is drawn through one harness, and every odd numbered end is drawn through another harness, and these two harnesses are made to rise and fall alternately, or first one and then the other is lifted, and a pick of filling passed through each opening, then cloth similar to this sample will be formed.

51. The harness draft is shown on design paper, and is best indicated by *numbers*, each number indicating through which harness the corresponding end is to be drawn. The harness draft may, however, be shown by means of crosses or dots.

52. A, Fig. 5, shows the weave for eight ends of the cloth sample, while B shows the harness draft for these 8 ends, or, in other words, the harness through which each end is drawn.

53. Referring, then, to Fig. 5, the numbers over each end in the weave A, indicate the number of the warp end. Taking each end in order, it will be seen that the 1st end is drawn through the 1st harness. This is shown in the harness draft B.

54. Continuing with the second end it will be seen that this end works *differently* from the first, therefore it must be drawn through a *separate harness*, or the second, as shown in B.

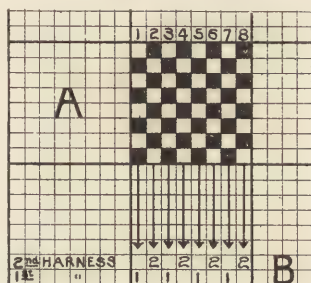


Fig. 5.

55. The third end in the weave works *like* the 1st, therefore it can be drawn through the *same harness* as the 1st end, which is the 1st harness; the 4th end works *like* the 2d, therefore draw it through the *same harness* with the 2d, which is the 2d harness.

56. Thus it will be seen that first one end is drawn through the first harness, and the next through the second, and that this is continued throughout the weave, and it may also be said that it is continued throughout the warp, every other end being drawn through the same harness.

57. This is all there is to any harness draft, it simply being a means of showing the person who draws in the warp ends *through which harness each end of the warp is to be drawn*.

58. Harness drafts are generally shown for only *one repeat* of the weave, since all other ends are drawn in in a manner similar to the ends in that repeat. Consequently in making out the harness draft for the weave of sample A, only the first two ends need to be shown, and therefore the first two ends in the harness draft B, Fig. 5, would show the manner of drawing in all the ends.

59. One other example will be given here, showing the weave, and the harness draft made from it.

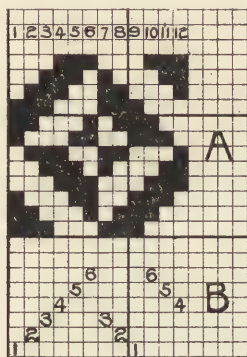


Fig. 6.

60. A, Fig. 6, shows a weave, while B shows the manner in which the ends, which make the weave, could be drawn into the harnesses. By noticing the weave the student will see that the first 6 ends (the numbers at the top of the weave show the number of each end) *all work differently*, therefore they must all be drawn through *separate harnesses*.

61. This is done in the harness draft B, which shows the 1st end drawn through the 1st harness, the 2d end drawn through the 2d harness, the 3d end drawn through the 3d harness, and so on, up to the 6th end, which is drawn through the 6th harness.

62. Next, noticing the 7th end of the weave it will be seen that this end is *exactly like the 3d end*, therefore it can be drawn through the *same harness as that end*, which is the 3d.

63. One point should be noted here by the student, which is that in making out a harness draft, each row of squares running *across* the paper represents a *harness*. Therefore, when making out a harness draft, as each end is indicated, the number must be placed in the row of squares representing that harness.

64. Thus, in this case the number 3, which shows that the 7th end is drawn through the 3rd harness, must be placed in a square which will represent the 7th end and also the 3d harness. By noticing the harness draft the student will see that this has been done.

65. Continuing then with the ends in the weave it will be seen that the 8th end is exactly like the 2d, therefore it can be drawn through the same harness as that end, which is the 2d harness. Indicate this in the harness draft as shown in B.

66. The 9th end is exactly like the 1st end, therefore draw it through the same harness with the 1st end, or the 1st harness.

67. The 10th end is like the 6th, the 11th like the 5th and the 12th like the 4th, therefore draw the 10th end through the 6th harness, the 11th end through the 5th harness, and the 12th end through the 4th harness. This will be found to be the order shown in the harness draft, or B, Fig. 6.

68. Different classes of drawing-in drafts and their uses, together with the different effects that can be formed in the cloth by using different harness drafts, will be spoken of later in this lesson, it simply being the object at present to show the student the relation that the weave bears to the harness draft.

69. After the harness draft has been made from the weave, in order to show the method of drawing in the warp ends, a plan must next be made to show how, or in what order, the harnesses, through which these ends are drawn, must be lifted on each pick in order to raise and lower the ends on each pick.

70. This plan is known as the **chain draft**, and the method of obtaining this chain draft from the weave and harness draft will be understood from the following explanation.

71. Referring to Fig. 5, it will be seen that the first end has been drawn through the first harness, and that all the ends working like the first end have also been drawn through that harness, so that if the first harness is raised and lowered in the same order that is indicated by the first end, then *all the ends drawn through that harness will interlace in the same manner.*

72. Again, the second end has been drawn through the second harness and also all the ends which work in a manner similar to the second, consequently if the second harness is raised and lowered in the same order as that indicated by the second end, then *all the ends drawn through that harness will interlace in a similar manner.*

73. The marks and blanks on the first end of the weave, as shown in A, Fig. 5, indicate the manner in which that end has to be raised or lowered, consequently *by raising the harness through which that end is drawn, or the first harness, in the same manner as the end is raised, all the ends drawn through that harness will be raised and lowered in their proper order.*

74. Again, the marks and blanks on the second end of the weave, as shown in A, Fig. 5, indicate the manner in which that end has to be raised and lowered, consequently *by raising the harness through which that end is drawn, or the second harness, in the same manner as the second end is raised, all the ends drawn through that harness will be raised and lowered in their proper order.*

75. This includes all the ends in the warp that work differently, and consequently all the harnesses that are necessary to weave the cloth.

76. The manner of lifting and lowering the harnesses, or in other words, the chain draft, is indicated on design paper by means of *blanks and filled in squares*, each *filled in square* indi-

cating that a harness is *raised*, while every *blank* shows that a harness is *lowered*.

77. To make a chain draft, having the weave and drawing in draft given :

Copy the interlacings of each end in one repeat of the weave, that is drawn in through a separate harness, as indicated by the harness draft, and place these interlacings of the ends in the same relative position that the harnesses, through which they are drawn, will occupy.

78. Fig. 3 shows one repeat of the weave of sample A, and it will be remembered that the first end is drawn through the first harness, therefore to show the manner in which this harness should be raised and lowered, *copy the interlacings of this first end*. The second end is drawn through the second harness, therefore to show the workings of this harness, *copy the interlacings of this end*, as shown in Fig. 3.

79. When this has been done, it will be noticed that the chain draft is similar to the weave as shown in Fig. 3, therefore this figure could be used to indicate the chain draft, as well as to show the weave.

80. To further enable the student to understand this part of designing, a chain draft will be made from the weave and harness draft shown in Fig. 6.

81. A, in Fig. 7, represents one repeat of the weave, B shows the harness or drawing-in draft, while C shows the chain draft.

82. The student should carefully note the difference in the rows of squares in each figure. Thus in A, which shows one repeat of the weave, *each row of squares from top to bottom represents one end, and each row of squares across the paper represents one pick*.

83. In B, which shows the harness draft, *each row of squares from top to bottom represents one end, the same as in A, but each row of squares across the page represents one harness*.

84. In C, which shows the chain draft, *each row of squares from top to bottom represents the working of one harness, while each row across the page represents one pick.*

These distinctions should constantly be kept in mind in order to understand the relations that exist between the three.

85. It has previously been stated that in order to make a chain draft from a weave it is simply necessary to copy the interlacings of those ends which are drawn on separate harnesses. Therefore, in order to ascertain the number of

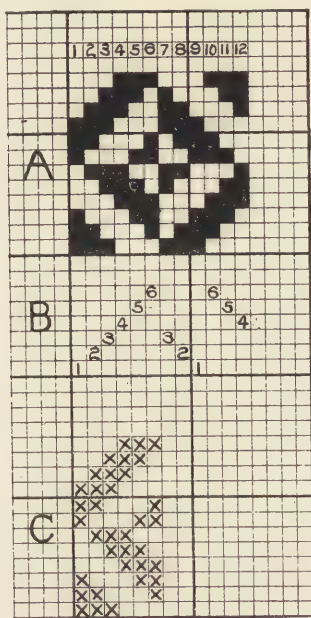


Fig. 7.

harnesses which any weave will take, it is only necessary to *find the number of harnesses that the drawing-in draft occupies.*

86. By referring to B, Fig. 7, it will be seen that 6 harnesses are used, and thus it is learned that only 6 vertical rows of squares will be required for the chain draft.

87. Proceeding then to copy the interlacings of those ends which are drawn on separate harnesses, the first end is drawn through the first harness, and it will be seen that the *first harness*, as shown in C, is marked the same as the *first end*, as shown in A.

88. The second end is drawn through the second harness, and consequently the *second harness*, as shown in C, is marked the same as the *second end*, as shown in A.

89. This method is continued with the first 6 ends, all of which are drawn through separate harnesses.

90. It will now be noticed that the seventh end of the weave is drawn through the third harness, but since the working of this harness has already been set down, it must not be marked again. The same can be said of the rest of the ends, all of which work in a manner similar to some one of the first 6 ends. Therefore the chain draft is complete, as shown at C.

91. The expression "chain draft" is derived from the harness chain which is used on a woolen loom.

This harness chain consists of bars upon which rollers or risers, and washers or sinkers are placed. Each bar on this chain works the harnesses for one pick, and wherever a mark is placed in a square of the chain draft, a riser is placed on the harness chain which will cause that harness to lift, and wherever a blank square is left in the chain draft, a sinker is placed on the harness chain, which will cause that harness to remain down.

92. The term **pegging plan** is also often used for chain draft, this expression being derived from the chain which is used on a cotton dobby loom to raise and lower the harnesses. This chain is made up of wooden bars, into which pegs are inserted, a peg being placed in a bar for each square that is marked on the chain draft, which will raise that harness, and a space being left for each blank in the chain draft, thus causing that harness to remain down.

93. The method of building harness chains from chain drafts, and the manner in which these harness chains operate

the harnesses, are fully explained in the lessons on weaving and no further mention of them will be made here.

EXAMPLES FOR PRACTICE.

94. 1. Give the drawing in draft for Fig. 8.



Fig. 8.

2. Give the chain draft for Fig. 8 to correspond with the drawing in draft shown in answer to question 1.

3. Fig. 9 shows a weave and drawing in draft, give the chain draft to correspond with the drawing in draft.

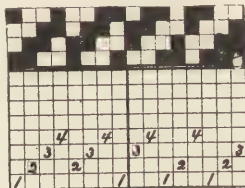


Fig. 9.

4. Give the drawing in draft for the weave shown in Fig. 10, placing all ends that work alike on the same harness.

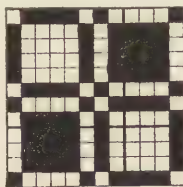


Fig. 10.

5. Give the chain draft for Fig. 10 to correspond with the drawing in draft shown in answer to question 4.

95. The weave, harness draft and chain draft, have thus far been explained in connection with a specific case, and the rest of this lesson will deal with these subjects in a more general way, illustrating the different kinds of harness drafts that are commonly used, and the method of showing different effects that will be formed in cloths by the use of different harness and chain drafts.

96. The weave may be said to effect a cloth in three ways.

First, the weave effects the *build* of the fabric. If the interlacings of the different ends are not equally balanced, that is if all the ends in one repeat of the weave do not interlace about the same number of times, it will be impossible to obtain a regular and uniform cloth. Fig. 11 is a weave which will serve to illustrate this point.

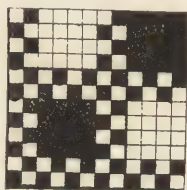


Fig. 11.

97. By examining this weave, it will be noticed that the 1st and 2d, also the 7th and 8th ends, make 12 interlacings, while the remaining ends only make 4 interlacings in one repeat of the weave.

98. An interlacing for a warp end is counted each time that a *given end passes over or under a pick*, and an interlacing for a pick is counted each time that a *given pick passes over or under an end*.

99. With a weave, such as is shown in Fig. 11, it would not be possible to produce a level cloth. This weave is known as a honeycomb, and a level cloth is not desired, but rather one with a honeycombed effect.

100. In the second place the weave may be said to effect the *appearance* of the cloth.

A great many different patterns are produced in woven fabrics by simply modifying or changing the method of crossing the warp and filling, no variety of colors or yarns being needed.

101. Again a weave may be used, in a figured design, which will effect the *development in the details of the pattern* quite as much as color.

102. For example, if the figure to be produced was required to show up boldly in certain parts of the design, weaves would be combined which would bring different proportions of the warp or filling to the face of the cloth.

103. It may further be stated that the number of interlacings in a weave will effect the *length* of warp used in making the cloth. Take, for example, the two weaves shown in Figs. 2 and 4. If two cloths were made from these weaves with the same number of picks per inch and the same counts of yarns, the plain cloth made with the weave, Fig. 2, would require to have a longer length of warp than the cloth woven with the weave shown in Fig. 4, that is if the two cloths were to be the same length.

104. This would be better understood by taking a piece of thread and interlacing it back and forth two or three times, between each finger of one hand, noting the length of thread taken, and then passing the thread back and forth again the same number of times, but this time interlacing the threads at intervals of two fingers, and then noticing the difference there is in the two lengths required.

105. It will be found that when more interlacings are employed, a longer thread is necessary. It is exactly the same principle, that necessitates a longer warp when there are more interlacings of the ends and picks.

106. Moreover the intersections effect the number of ends and picks that can be placed in one inch of the cloth; the

general rule being that the greater the number of interlacings of the ends and picks, the smaller the number of ends or picks that can be crowded together.

107. The harness draft will now be considered in relation to the standard methods of drawing the warp ends through the harnesses, and also in relation to the reduction of designs.

108. The simplest form of drafting, is that of the plain weave. As previously explained, in this weave there are only two ends and two picks in one repeat of the weave, and the ends are drawn through two harnesses, first, an end through one harness, and then the next end through the other harness.

109. This drawing in draft for the plain weave represents one of the standard methods of drafting, and is known as a **straight draft**.

110. *A straight draft is one in which the ends are drawn through the harnesses in regular order from front to back.*

111. To illustrate this, suppose a weave occupied 10 harnesses, and the ends were drawn straight from the front harness to the back harness. Then the first end would be drawn through the first harness, the second end through the second harness, the third end through the third harness, and this would be continued up to the tenth end, which would be drawn through the tenth harness.

112. Then the drawing in draft would commence with the first harness again, and the next end would be drawn through that harness, that is, the eleventh end would be drawn through the first harness, the twelfth end through the second harness, and so on. This is repeated in this manner until all the ends in the warp have been drawn in.

113. Fig. 12 is an illustration of two repeats of a straight drawing in draft on 5 harnesses.

This figure illustrates another method of representing the harness draft, the lines running across the page being the harnesses, while the vertical lines are the warp ends, the crosses

showing through which harness the warp end to which it is attached is drawn.

114. Thus it will be seen, by referring to this figure, that the first end is drawn through the first harness, the second end through the second harness, and so on, up to the fifth end, which is drawn through the fifth harness.

115. It will now be noticed that the harness draft commences to repeat, that is the next end, which is the sixth, is drawn through the first harness, the seventh end is drawn through the second harness, and continues in this manner up to the tenth end, which is drawn through the fifth harness.

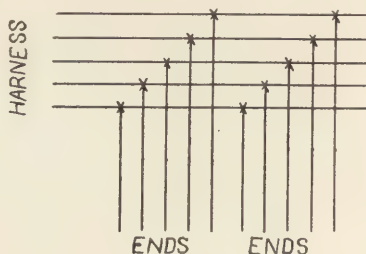


Fig. 12.

116. Here the harness draft commences to repeat again, and the next end, which is the eleventh, if it was shown, would be drawn through the first harness.

117. As previously stated, this method of drawing in the warp ends is known as the straight draft, and is one that is very commonly used.

118. Another method of drawing in warps, which will be met with very frequently, is that known as the **centre or point draft**.

119. In **regular point drafts** the ends are drawn from the front to the back harness, and then the method of drawing in is *reversed*, that is, after drawing in the end in the back harness the next end is drawn through the *next to the back* harness, thus running from back to front.

120. Fig. 13 is an illustration of a regular point draw on 8 harnesses. By referring to this figure it will be noticed that the first end is drawn through the first harness, the second end through the second harness, and continuing in this manner up to the eighth end, which is drawn through the eighth harness.

121. The next end, which is the ninth, instead of being drawn through the first harness, as would be done in a straight draft, is drawn through the *next to the back*, or the *seventh* harness. The ends are now drawn in from back to front, the *fourteenth* end being drawn in through the *second* harness. The draft commences to repeat here. In this figure dots are used in place of numbers.

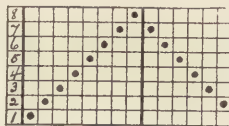


Fig. 13.

122. With a regular point draft the student should carefully note the following points:

The last end of the repeat should always be drawn through the second harness.

The drawing in draft should never commence and end with the same harness.

One repeat of the drawing in draft is always complete on a number of ends which is *two less than twice the number of harnesses employed*.

123. Thus in Fig. 13 the student will note that the draft occupies 8 harnesses, and that one repeat is complete on 14 ends.

$$2 \times 8 = 16$$

$$16 - 2 = 14 = \text{the number of ends on which one repeat of the draft is complete.}$$

124. Another system of point draws is illustrated in Fig. 14, which shows an **irregular** point draft.

In these drafts the ends are drawn through the harnesses straight for a certain number of times, and then reversed as in a regular point draw.

125. By noticing Fig. 14, the student will readily see that the ends have been drawn in straight on 7 harnesses, for three times, and then reversed. The student should again notice that the last end of the repeat is drawn through the *second* harness.

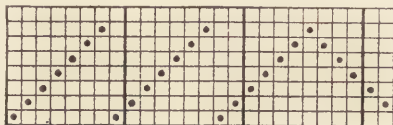


Fig. 14.

126. Still another system of irregular point draws is illustrated in Fig. 15. The method adopted in this case is that of running the ends straight for a certain number, and then reversing, but only running the ends for a *few* harnesses, when they are again run straight and again reversed.

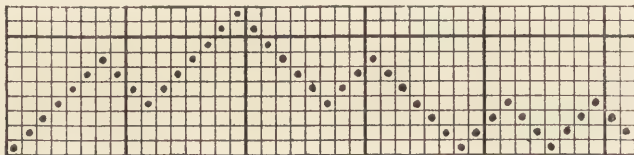


Fig. 15.

127. The student will notice that a repeat of the draft occupies 10 harnesses and 42 ends, and also that the last end of the repeat is drawn through the second harness.

128. Another standard method of drawing in the ends is that known as the **angled draft**, in which the ends are drawn straight for a certain number of harnesses, and then reversed, but the reversing *starting half way the number of harnesses used*.

129. Fig. 16 gives an illustration of this style of draft on 8 harnesses. By noticing this figure the student will see that

the first eight ends are drawn straight, and the method of drawing is then reversed, that is, instead of drawing from front to back, as is the case with the first eight ends, the ends are now drawn from back to front.

130. However, instead of commencing with the seventh harness and drawing the ninth end through that harness, the ninth end is drawn through the *fourth* harness, the tenth end through the third harness, and so on, until an end has been drawn through each harness in this manner, which will complete one repeat of the draft.

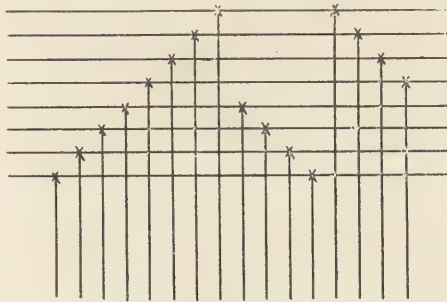


Fig. 16.

131. That different drawing in drafts will give widely different results in the cloth even if the same chain draft is used, will be readily apparent to the student, if a little thought is given to this subject.

132. The effect that will be produced in a cloth by given harness and chain drafts may be easily ascertained by simply *copying the interlacings of the ends as they are indicated by these drafts.*

133. The effect is practically the weave, and consequently finding the effect when the harness and chain drafts are given, is simply the *reverse of finding the harness and chain drafts when the weave is given.*

134. To illustrate this point an example will be given here. Suppose that Fig. 17 is a chain draft for a weave,

and the ends are drawn in straight on eight harnesses, then the effect in the cloth would be *exactly like the chain draft*, since the first end would work like the first harness of the chain draft, and consequently the interlacings of that end would be similar to the rising and falling of that harness.

135. The same may be said of all the ends, and for this reason the effect would be exactly like the chain draft.

136. It may be stated here that when a straight harness draft is used, the *chain draft is always exactly like one repeat of the weave*, and on the other hand the effect produced by any chain draft with a straight harness draft, is always *similar to the chain draft*.

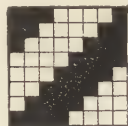


Fig. 17.

137. In the next case, suppose that the same chain draft or Fig. 17 is used, but in this case the harness draft as shown in Fig. 13 is used, in place of the straight draft, and it is desired to learn what effect this would produce in the cloth.

138. As previously stated, the manner in which the harnesses rise and fall, as shown in the chain draft, will give the manner in which the ends, drawn through those harnesses, interlace with the filling.

139. Therefore if it is desired to learn how a certain end interweaves it is simply necessary to *copy the order of lifting and lowering the harness through which that end is drawn*, and since the harness draft shows through which harness any end is drawn, while the chain draft shows when each harness is up and when down, it is possible from these two drafts to tell exactly how each end interweaves.

140. Therefore proceeding in this manner in order to learn the effect produced with Fig. 17 as a chain draft, and Fig. 13 as a harness draft, it will be seen that since the first end is drawn through the first harness, it will rise and fall with that harness,

and consequently the lifting of the first harness, as shown in the chain draft, *represents the manner in which the first end interweaves*, therefore copy this for the first end of the effect. By referring to Fig. 18, which shows the effect, it will be seen that this has been done.

141. The second end is drawn through the second harness, therefore copy the lifting and lowering of this harness, in order to show the interweaving of this end. This has been done in Fig. 18. Continue in this manner with the first eight ends.

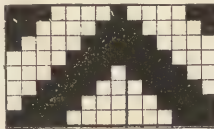


Fig. 18.

142. It will now be noticed that the ninth end is drawn through the seventh harness, therefore to show the interweaving of this end it is necessary to copy the order of lifting and lowering that harness as shown in the chain draft. Continue in this manner with all the ends shown in the harness draft and the effect shown in Fig. 18 will be obtained.

143. Again suppose that the same chain draft is still used, but that in this case the harness draft as shown in Fig. 16 is used, and it is desired to show the effect that would be produced.

144. Fig. 19 shows the effect, and it is hardly necessary to go into any detailed explanation of the manner in which this is obtained, owing to the previous one having been fully dealt with.

145. It will do no harm, however, to call attention to the ninth end, as shown in the effect. By noticing the harness draft, Fig. 16, it will be seen that the ninth end is drawn through the fourth harness, therefore in representing this end in the effect, it is necessary, as previously stated, to copy the lifting and lowering of this harness as shown in the chain draft.

146. By noticing the effect, Fig. 19, it will be seen that the working of the ninth end is similar to the working of the

fourth harness as shown in the chain draft, Fig. 17. The working of the tenth end is similar to the working of the third harness, since it is drawn through that harness, the working of the eleventh end is similar to the working of the second harness, since the eleventh end is drawn through that harness, and in short, by examining the ends as shown in the effect, Fig. 19, it will be seen that they all work in a manner similar to the harnesses through which they are drawn.

147. From these explanations the student will readily understand that it is a simple matter to obtain several effects in the cloth when using the same chain draft, by simply altering the harness draft.

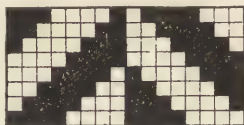


Fig. 19.

148. On the other hand, it will be readily understood that it would be possible to obtain different effects, with the *same harness draft*, by simply *changing the chain draft*, since if the harnesses are made to rise and fall differently, it would of necessity cause the ends drawn through these harnesses to also rise and fall differently, and thus change the manner of interweaving the ends, and consequently changing the effect.

149. The student should, however, carefully note that the chain draft and harness draft must always occupy exactly the *same number of harnesses*.

150. As has already been shown, when two or more ends, in one repeat of a weave, have the same interlacings, it is possible to draw such ends through the same harness, but as will be explained later, it may not always be advisable to do so.

151. It would be possible, if the loom would operate the necessary number of harnesses, to draw each end in one repeat of a weave through a separate harness, or in other words to

use a straight draft for every weave, in which case one repeat of the weave would always be the chain draft, but owing to the large number of ends occupied by a single repeat of some weaves it is not always practicable to do so, and consequently it becomes necessary to draw those ends working alike through the same harnesses.

152. However, this is a matter in which a person must use his judgment to a large extent, constantly remembering that *the nearer the drawing in draft can be brought to a straight draw, the better it will be for the weaving in every way.*

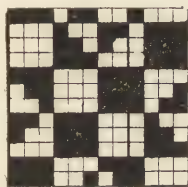


Fig. 20.

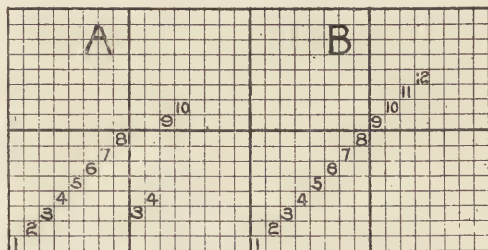


Fig. 21.

153. As an illustration of this point, suppose that the weave shown in Fig. 20 was to be used, and it was desired to make the harness draft for this weave.

154. By carefully noting this weave the student will see that the ninth end works like the third, and therefore can be drawn through the same harness as the third end, which is the third harness. Also the tenth end works like the fourth end and can therefore be drawn through the harness with the fourth end.

155. The harness draft could then be made out similar to A, Fig. 21, which would place the weave on ten harnesses, but it will be noticed that by doing this a break is made in the drawing in draft, which would make it harder for the drawing-in hand to draw in the warp; also more difficult for the weaver to draw in any ends that might break out during weaving.

156. A better plan, therefore, would be to draw the ends in straight on 12 harnesses, as shown in B, Fig. 21.

157. A somewhat better understanding of this subject will be obtained by carefully considering the following figures.

Fig. 22 shows a weave, which it is desired to draft in the most practical manner. The crosses, which are placed in the squares at the right, should be considered to be similar to filled in squares.

158. By examining this weave, then, it will be seen that the first three ends (always counting from the left) are entirely different, therefore the first end will be drawn through the first harness, the second end through the second harness and the third end through the third harness. Next it will be seen that the fourth end is like the second, therefore it can be drawn through the harness with the second end.

159. It will now be noticed that the fifth, sixth, seventh and eighth ends interlace in a manner similar to the first, second, third and fourth respectively, therefore they would be drawn in the harnesses in the same manner as the first four.

160. Again it will be noticed that the 9th, 10th, 11th, 12th, the 13th, 14th, 15th, 16th, the 17th, 18th, 19th, 20th, and the 21st, 22d, 23d, 24th ends, are simply repetitions of the first four ends, and consequently can be drawn in in the same manner as were the first four.

161. Next noticing the 25th end, it will be seen that it works like the ends which are drawn through the first harness, while the 26th end works like the ends drawn through the 3d harness, therefore these ends would be drawn through these harnesses. The 27th end is similar to the 25th, and the 28th, is like the 26th.

162. If the ends should be drawn in in the manner just described, then the harness draft would be similar to Fig. 23, and the chain draft for this harness draft is shown in Fig. 24.

163. As previously stated however, one object that should always be sought for, when making a harness draft, is the best and most practical way of performing everything connected with the production of the design in the cloth.

164. With this object in view then, consider the harness draft as shown in Fig. 23. It will be readily understood that by placing all the ends on three harnesses they would be more crowded than if they were placed on more harnesses. Again, the more crowded the ends are in the harnesses, the more difficult it always is for the weaver to draw in the broken ends.

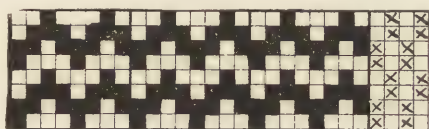


Fig. 22.



Fig. 24.



Fig. 23.



Fig. 25.



Fig. 26.

165. Another consideration, when drafting, is to have, as nearly as possible, the *same number of ends on each harness*. If the number of ends on each harness is equal and the same number of harnesses are raised on each pick, there will be the same uniform strain on the harness motion of the loom.

166. On the other hand, when some harnesses contain more ends than others, heavy and light lifts are forced upon the loom mechanism at different times, and a jerky movement of the loom is generally the result.

167. By noticing Fig. 23, it will be seen that, *in one repeat of the weave*, 8 ends are drawn through the first harness and also 8 ends through the third harness, while there are 12 ends drawn through the second harness.

168. As a result of this method of drawing in the ends it would necessarily take more power to lift the second harness than it would to lift the first or the third.

169. Suppose now that instead of drawing the ends as shown in Fig. 20, the first end is drawn through the first harness, the second end through the second harness, the third end through the third harness and the fourth end through the fourth harness, then draw the next four ends in the same manner as the first four and repeat this order until the 25th end is reached, which would be drawn through the first harness.

170. The 26th end would be drawn through the third harness, the 27th through the first, and the 28th through the third. The harness draft for the ends when drawn in in this manner is shown in Fig. 25, while Fig. 26 shows the chain draft for this harness draft.

171. The student will readily understand that such an order of drawing in the ends would be much preferable to that shown in Fig. 23.

EXAMPLES FOR PRACTICE.

172. 1. Fill 8x8 small squares of design paper with the plain weave, and show the harness and chain drafts that would be used if the cloth was to be woven on four harnesses, straight draw.

2. A plain cloth is to be woven on four harnesses, with the first end drawn through the first harness, the second end drawn through the third harness, the third end through the second harness, and the fourth end through the fourth harness, show the chain draft.

3. Show the effect that would be produced in the cloth by using a regular point draft with Fig. 27, for the chain draft.

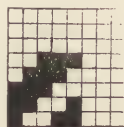


Fig. 27.

4. Show an irregular point draft on 12 harnesses; show the effect that would be produced, using Fig. 6 for a chain draft.

CLOTH ANALYSIS.

173. A prominent part of every designer's duties is the **analysis** of fabrics, and in order that the student may obtain a good knowledge of cloth construction, it is necessary that considerable time should be devoted to this branch of the study.

174. By the term "analysis" is meant the dissecting of a sample of cloth and learning all the particulars which are required in order to manufacture cloth which will be similar in every respect.

175. Thus, for an example, a small piece of cloth may be given to the designer, or in case the mill does not have a designer, it may be given to the boss weaver or superintendent, with instructions to make cloth exactly like the sample.

176. Again the instructions may be to make cloth which will look like the sample and yet not be as high priced a fabric. In other cases it may be necessary to change several particulars of the sample such as the weight, etc.

177. If the student bears in mind that cloth may be reproduced in various ways, but that there is *one* way which is most economical and advantageous to the mill, it will readily be seen that this is a subject which can not have too much attention, in fact it is one which requires constant study.

178. It is the object of this lesson to point out to the student the various particulars which are necessary when wishing to reproduce a sample of cloth, and the methods employed to obtain these particulars.

179. With the lessons on Designing, the student will receive samples of cloth which will illustrate certain of the

weaves explained in the lesson paper and which it will be necessary to analyze; but what has just been said in regard to constant practice should be remembered, and whenever a chance presents itself to study a piece of cloth, the student should avail himself of the opportunity.

180. By this means new weaves, new combinations of weaves and new color effects will be met with, and if the student thoroughly masters them, they will be understood much better than by simply studying designs marked out on design paper.

181. A list of the particulars necessary to obtain, when reproducing a sample of cloth, will be given here, and later in this lesson the method of obtaining each particular will be illustrated, taking as a sample of cloth the piece which the student received with Part VII. of Calculations.

182. This list is as follows:

1. Sley of cloth, (average sley if necessary.)
2. Ends in the warp.
3. Warp Pattern, (if any.)
(a) Number of patterns in the warp.
4. Twist of warp.
5. Counts of warp.
6. Picks per inch.
7. Filling Pattern, (if any.)
8. Twist of Filling.
9. Counts of filling.
10. Yds. per lb.
11. Reed to be used.
12. Width at reed.
13. Weave.
14. Harness Draft.
15. Chain Draft.

NOTE. The desired width of the cloth, in all cases will be supposed to be given.

183. There are also a few other particulars which must be considered when reproducing cloth and which will be dealt with in the latter part of this lesson. These, however, will not be required of the student in connection with the analysis of samples.

184. By carefully noting the list of items given in Clause 182 it will readily be seen that several of the particulars are the same as those dealt with under the subject of cloth calculations, and consequently will not need to be again explained here.

185. However, the student should carefully review that part of Calculations and study it together with this lesson. By following this method there should be no difficulty in fully understanding how to obtain all the particulars necessary for the reproduction of a sample of cloth.

186. It will be seen that the first and second items were explained previously and will not need to be considered here.

In regard to the third item, the word "pattern" has previously been defined, but there are a few additional points in connection with this particular that need to be dealt with here. One of these is the *method* of making out a warp pattern.

187. It should be stated here that different mills employ different methods in most every branch of manufacturing, and it is never advisable for a person to try to revolutionize old methods, if they are satisfactory, but rather to adapt himself to the existing methods, since by this means, it is only necessary for one person to understand the change, whereas in the other case it would be necessary for several to adapt themselves to new systems, which is very liable to result in serious errors.

188. It is obviously impossible to explain in these lessons all the methods adopted, and in fact it would not be for the interests of the students to do so. In explaining each subject, what appears to be the simplest and yet the best method of making out instructions will be given, and it will then rest

with the student to modify these or not, to meet his own personal requirements and those of the mill in which he is employed.

189. To illustrate the method of making out a warp pattern, it will be assumed that the pattern contains yarn in the following order :

1 end 30s light blue,
 1 end 2 ply 20s white,
 10 ends 30s dark blue,
 1 end 2 ply 20s white,
 10 ends 30s dark blue,
 1 end 2 ply 20s white,
 1 end 30s light blue,
 4 ends 30s white,
 1 end fancy,
 4 ends 30s white,
 1 end fancy,
 4 ends 30s white,
 1 end fancy,
 4 ends 30s white,
 1 end fancy,
 4 ends 30s white.

It will be seen that the above will readily show the warp pattern, but this can be shortened somewhat by enclosing a portion in brackets, and indicating the number of times that part is repeated, as follows :

1 end 30s light blue,
 1 end 2 ply 20s white,
 2 x { 10 ends 30s dark blue,
 1 end 2 ply 20s white,
 1 end 30s light blue,
 4 x { 4 ends 30s white,
 1 end fancy,
 4 ends 30s white,
 49 ends in the pattern.

190. Another convenient method of showing this pattern is as follows :

WARP													
30s light blue {	1					1							= 2
30s dark blue {			1 0		1 0								= 20
30s white {							4		4		4		= 20
30s fancy {							1		1		1		= 4
2 ply 20s white {		1		1		1							= 3
													49
													ends per pattern.

191. Or again this could be somewhat shortened as follows :

WARP													
30s light blue {	1				1								= 2
30s dark blue {			1 0										= 20
30s white {						4		4					= 20
30s fancy {							1						= 4
2 ply 20s white {		1		1									= 3
													2 ×
													4 ×
													49 ends per pattern.

192. The marks 2× and 4× show that the ends inside the brackets are to be taken two times and four times. By carefully comparing these two drafts, the method adopted in the second one will readily be understood.

193. After the number of ends in one pattern of the warp has been learned it is an easy matter to ascertain the number of patterns in the warp by simply *dividing the total number of ends in the warp by the number of ends in one pattern*, or this particular may be learned by *dividing the total number of dents occupied in the reed, by the number of dents occupied by one pattern*. This has been thoroughly explained in Part VII. of Calculations and needs no further explanation here.

194. In the case of a piece of cloth like the sample sent with Part VII. of Calculations, the warp pattern would be known as all white, but the effect produced in the cloth would be obtained by the method of drawing the ends in the reed and the order of raising the harnesses. The manner in which the ends are reeded is indicated by what is known as the **reed draft**, which will be explained in connection with the harness draft.

195. By the term "**twist of yarn**" is meant both the *direction* of the twist and also the *amount* of twist, that is the number of turns per inch, placed in the yarn.



Fig. 28.



Fig. 29.

196. The direction of the twist of the yarns in a cloth becomes an important matter when reproducing cloth, since an entirely different effect may be produced by simply changing the twist in either the warp or filling.

197. Yarns may be twisted in one of two directions, which are technically known as *right* twist and *left* twist. There is considerable difference of opinion as to what constitutes a right twist and a left twist yarn, as some mills consider a yarn as right twist which in other mills would be considered as a left twist.

198. However, the character of the yarns, to which these names are most commonly applied will be explained here, and if the student should chance to hear a yarn spoken of as directly opposite to what is stated, the above explanation should be borne in mind.

199. By holding the yarn between the thumb and finger of each hand the direction of the twist may be learned. When held in this position turn the yarn away from the body by means of the right hand. If when turning the yarn in this manner it is *twisted harder* it is *left* twist, but if the yarn is *untwisted* when turned in this manner it is *right* twist.

200. Fig. 28 indicates a yarn which would be known as a right twist yarn, while Fig. 29 illustrates a left twist yarn.

201. By closely examining the warp yarns in the sample, it will be seen that they are right twist.

202. As previously stated, twist also refers to the number of turns or twists that are put in the yarn in one inch.

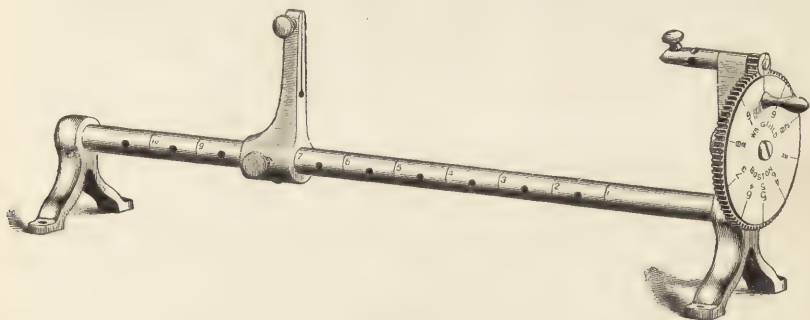


Fig. 30.

In case of a ply yarn this can readily be ascertained by putting the yarn under the pick glass, or in some cases without a pick glass, and counting the turns in one inch.

203. The amount of twist in any yarn may be found by means of an instrument made for the purpose of unwinding the twisted yarn and indicating the number of revolutions made in taking out all the twist.

204. There are several different kinds of instruments made for determining the number of twists in a given length of yarn and the reduction in length that is caused by this twist.

Fig. 30 is an illustration of a twist counter adapted for lengths of from one to ten inches, and for either right or left hand twist.

205. In this instrument the yarn is held at both ends, and one end is turned until all the twist has been taken out of the yarn, the instrument having recorded the number of turns.

206. The method of obtaining the fifth and sixth items, namely the *counts* of the warp and the *picks* per inch have been thoroughly explained in Part VII. of Calculations and consequently require no further explanation here.

207. When considering the **pattern of the filling**, what has already been said in regard to the pattern of the warp should be noted, since both may be shown in the same manner.

208. By the term "pattern of the filling" is meant the manner in which the filling is inserted in the cloth, either as regards different *color* or different *counts* of yarn.

209. In making out the pattern of the filling in any cloth it is simply necessary to give the *number of picks of each color or count in one repeat of the pattern*, and this can be shown in the same manner as was the pattern of the warp.

210. In case the filling is all of one color and counts, there would of course be no pattern, and it would simply be stated, all white, all black, etc., according to whatever color of yarn was used.

211. Thus with the sample of cloth being considered the filling is white, and all the same counts, and consequently the pattern of the filling would be shown by saying "all white."

212. The twist of the filling is determined in the same manner as was the twist of the warp, and if the student examines the filling yarns of this sample of cloth, it will be seen that they are right twist. That is, they are twisted in the same direction as the warp yarns.

213. The ninth, tenth, eleventh and twelfth items, or the counts of the filling, yds. per lb., reed to be used and the width at the reed, were all dealt with in Part VII. of Calculations and will not be further dealt with in this lesson.

214. The student no doubt understands before this how closely connected are cloth dissection and cloth calculations, and it should be unnecessary to further urge the necessity of a thorough understanding of the calculations in order to master the subject of cloth analysis.

215. The thirteenth item in the list of particulars, or the **weave**, is probably one of the most important, and one which will require considerable study and practice from the student, although after the weaves of a few samples have been studied and successfully obtained, it will be a comparatively easy matter to obtain the weaves of any other samples that the student may chance to come across, in fact many samples will be met with which will not require much more than a glance to determine the weave.

216. By the term "weave" is meant the manner in which the warp yarns and the filling interlace, and is shown on design paper by means of filled in squares and blanks. That is by looking at the weave as shown on design paper it is possible to determine just how *each thread of the warp is lifted and lowered*.

217. When obtaining the weave of a sample of cloth, the first thing necessary is to determine the *face* and *back* of the fabric, and also *which threads form the warp and which the filling*. These two points will be dealt with to a greater extent in the latter part of this lesson, it simply being necessary here to point out the importance of determining these points before commencing to obtain the weave.

218. It will be readily seen by the student that if the back of a cloth was taken as the face, then the warp ends would be up when in reality they should be down, and the reverse would also be true. On the other hand, if the warp was considered as the filling, a correct reproduction of the sample could not be obtained.

219. After the face and back, also the warp and filling have

been determined, hold the sample in such a manner that the *face side will be up and the filling will run from side to side.*

220. The manner of obtaining the weave of a sample of cloth is termed "**picking out,**" and as the name implies, consists of *picking out a pick of filling at a time and setting down on the design paper the way in which it interlaces with the warp.*

221. Thus if it was over the first end, the square representing that end would be left blank, if the filling was under the next end, then the square representing that end would be filled in.

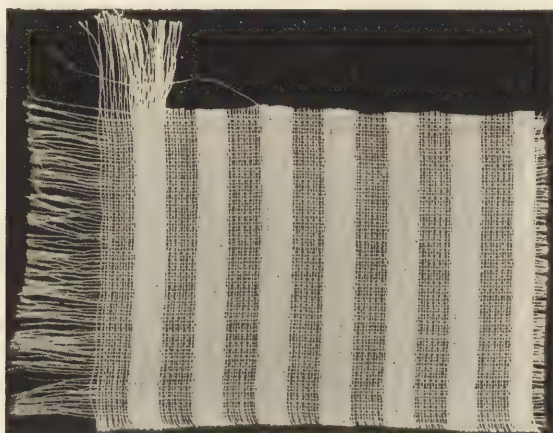


Fig. 31.

222. Before commencing to pick out a weave, it is a good plan to pull out several ends from the left of the sample and also several picks from the top. After the picks have been pulled out, cut off all the loose ends with the exception of what are needed to determine the weave.

223. Only the ends which form *one repeat of the weave* will generally be found to be sufficient to leave at the top. When the sample has been arranged in this manner it will have the appearance of the sample shown in Fig. 31.

224. After the sample has been arranged in this manner *hold it in the left hand, laying it over the first finger*, so that when each end has been dealt with it can be drawn under the thumb and out of the way, since in this manner the student can more readily keep the ends separate and determine their interlacings.

225. Another method that may be used to advantage in several cases, is to lay the sample on a white surface if it contains dark colored yarns, and upon a black surface if the yarns are light. By this means the interlacings will often show up much more prominently.

226. Which-ever method is adopted, next draw the *top pick* up a little from the cloth until its interlacings with the ends which have been left can be readily seen.

227. Commence with the end on the left and taking each end in successive order, mark on the design paper whether the pick of filling is above or below each end. That is, if the pick is *above* an end the square on the design paper is left *blank*, if the pick of filling is *below* an end the square is *marked*.

228. In this connection there is one important point that should be carefully noted by the student.

The interlacings of the *first, or top pick* should be placed upon the *top row of squares* on the design paper and the interlacing of the *first end*, or the end at the left, with the first pick should be shown on the *first row of squares at the left* on the design paper.

229. That is, the interlacing of the *first, or left hand end* with the *first, or top pick* will be shown by the square in the *upper left hand corner of the design paper*.

230. The top pick, however, will not be the first pick to be placed in the loom since this would produce the cloth with the top for the bottom and vice versa. It will be seen then that the *last pick* of the pattern will be the *first pick* to be placed in the loom and consequently the *lower left hand corner* of the

pick out when shown on design paper is considered the *first end and pick*.

231. This is rather a difficult point for a beginner to understand and it will be as well to state here that it is simply necessary in this connection to know that, when a piece of cloth is picked out after the manner described here, the lower left hand square of the design paper represents the first end and the first pick, since this is an important point when building a harness chain from the draft.

232. This has been dealt with in Part V. of Weaving and the student should consider the explanations given there, when trying to understand these points.

233. It should be mentioned here that some designers commence at the bottom of a piece of cloth to pick out and some also mark squares for ends depressed and leave squares blank for ends raised.

234. If the student has had any previous experience with designing, it will probably be better to continue with the methods adopted in the first place, but if he has not had any experience, the best plan will be to follow the methods explained in this lesson, as these will be found to be as simple as any and the ones in most general use.

235. After the interlacings of the first pick have been found and placed upon the design paper, draw it out of the cloth entirely and then draw the next pick up amongst the loose ends the same as when dealing with the first pick.

236. Find the interlacings of this pick and mark them upon the design paper on the *next horizontal row of squares below the row of squares marked for the first pick*.

237. After marking the interlacings of the second pick, proceed in a similar manner with the third and each successive pick until picks are found which interlace in a manner *similar to the picks which were first taken out which generally indicates that the weave repeats at this point*.

238. It is a good plan to pick out three or four picks of filling after the student thinks that the weave has commenced to repeat, and compare these with the first picks taken out to make sure that the weave does repeat at this point, although these extra picks must of course be crossed out afterwards, and only one repeat of the weave used when obtaining further particulars.

239. So much has already been said in Part I. regarding a repeat of a weave that it seems unnecessary to further dwell upon this subject.

240. When one repeat of the weave is obtained, it represents what is repeated as many times as required in the length and width of the same piece of cloth. One repeat of the weave therefore is all that is required.

241. The quickest plan of indicating the weave on the design paper is to first prick the squares that represent warp ends lifted, with the pick out needle, and then after the weave has been found, fill these squares in with ink.

242. This means that instead of laying down the picking out needle and taking up the pen or pencil every time the square needs to be marked, the needle will serve the purpose just as well until the dissection is completed.

243. If the sample of cloth to be dissected contains a large number of ends and picks per inch, or warp and filling yarns of the same shade, the yarns are liable to become crossed, and the wrong end marked on the design paper.

244. To prevent this, it is an advantage, before starting to pick out, to tie white cotton threads to the warp yarns and place them in a comb, attaching the ends together between two pieces of paper by mucilage in order to prevent them from slipping back.

245. If the sample of cloth is large enough this method may be simplified by pulling out a sufficient number of picks to allow the ends to be placed in the comb. If the ends are

crossed, or in their wrong order when placed in the comb, this will be noticed before the design repeats, and by making a note of where these crossed ends should be, they may be re-copied in their proper order after the design is found to repeat.

The above method will be found to be of advantage when dissecting any cloth difficult to analyze.

246. A good aid to dissecting warp backed and double cloths is to cut the backing ends after the necessary number of picks have been taken out, about $\frac{1}{8}$ or $\frac{1}{4}$ of an inch shorter than the face ends. If the fabric is hard felted or has a nap, singe it and scrape off the fibre, being careful not to injure the body of the yarns.

247. In a good many cases where the weave of a cloth is regular and one commonly used, such as a regular twill, it will not be necessary, after a little experience, to pick out more than one or two picks since these will show the manner of the interlacings in the whole weave, and the student can readily run the weave up without dissecting. Twills and other weaves commonly used will be explained in future lessons.

248. Fig. 32 shows one repeat of the weave of the cloth sample.

It should be stated here that if the student picks this weave out for himself, the result may not be exactly similar to that shown in Fig. 32, that is, the student's result and the one shown here may not compare pick for pick and end for end, yet the pick out that the student obtains may be correct.

249. This will be due to the fact that the two pick outs may not be started on the *same end* and the *same pick*. It will be readily apparent, with a little thought, that if they are not started on the same end and the same pick, then the first ends and the first picks of the two pick outs will not be alike.

250. There are several important points that can be learned from this weave and it will be well for the student to note the following somewhat carefully.

251. It will be noticed, by referring to Fig. 32, that the first twelve ends consist of the plain weave which is complete on *two ends and two picks*, or in other words, it takes only four squares to show this weave. Consequently when the student is picking out a weave of this kind it is only necessary to take out two picks in order to learn the weave, after which it may be continued for as many ends and picks as may be desired, by simply repeating the first two ends and picks.

252. With weaves as simple as this, the student will, after a little practice, be able to place the weave on the design paper, by simply observing the cloth by means of the pick glass.

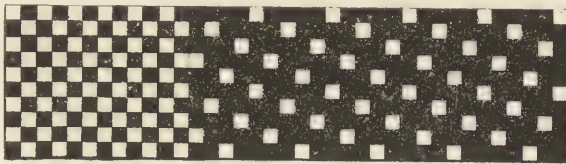


Fig. 32.

253. It will next be noticed that after the first twelve ends, as shown in Fig. 32, a different weave is employed, and that one repeat of this weave is complete on *five ends* although the entire weave occupies twenty-five ends.

254. What was previously stated in regard to picking out only one repeat of the weave applies equally well here. This weave is known as a *five end warp satin*. Satin weaves will be fully explained in future lessons, so that the student when meeting these in the cloth will be able at a glance to give the weave.

255. Another very important point in this connection is that one of these weaves, namely the plain weave, is complete on *two ends and two picks*, while the satin weave is complete on *five ends and five picks*.

256. It might naturally be supposed that in order to show the complete weave, only five picks would have to be taken out, but with a little thought it will be seen that the two weaves

must **repeat together** and that a plain weave can not repeat on an *odd number of picks*. Consequently while the satin weave would repeat on five picks the *plain weave would not*.

257. When two separate weaves are combined in a cloth similar to this one, the weave will not repeat in its picks until it is continued for a number of picks which is a *multiple of the numbers representing the picks each weave is complete on*.

258. Naturally the *least common multiple*, will give the number of picks on which the entire weave repeats. For example, the plain weave is complete on two picks and the satin weave on five picks. The least common multiple of two and five is ten. Therefore the entire weave is complete on ten picks.

259. Still another very important point that can be illustrated from this sample of cloth is the **matching up** of two weaves when used in the same cloth.

260. By again referring to Fig. 32, the student will notice that the plain weave ends on the twelfth end and the satin weave commences on the thirteenth end. In order to have the cloth show as neat an effect as possible these two ends should **cut** or **oppose** each other, that is where a square is *marked* on the twelfth end, the next square to it on the thirteenth end should be left *blank*.

261. By referring to Fig. 32 it will be seen that on the first pick the twelfth end is *down* while the thirteenth end is *up*, thus they oppose each other; on the second pick the twelfth end is *up* and the thirteenth end *down*, thus causing the two ends to oppose each other.

262. They also cut on the third pick, but on the *fourth* pick it will be noticed that *both* ends are *up* and consequently do not cut. The effect at this point will not be as neat in the cloth as it is where the ends oppose.

It should be stated here that it is not possible to have a plain weave cut at every point when combined with a five end satin.

263. When desiring to have two weaves cut, *both* places where the weaves join should be carefully noticed, thus in Fig. 32 it will be noticed that the two weaves not only join at the twelfth and thirteenth ends, but also at the *first* and *last*, since in showing a second repeat of the entire weave the *first end would be brought next to the last end*.

264. The student should understand that every piece of cloth is not made up of separate weaves, as this is rather the exception than the rule and generally a cloth will be found to be made from but one weave repeated a number of times.

265. This sample of cloth was taken as an illustration since it offered a means of pointing out so many important points that should be taken into consideration in many cases.

266. After the weave of a sample of cloth has been ascertained it next becomes necessary to obtain the **harness** and **chain drafts** in order to reproduce the cloth in the loom.

267. The harness and chain drafts are always obtained from the weave and as the method of obtaining these items has been fully explained in Part I. of Designing, it will not be necessary to explain this here. The student, however, should thoroughly understand what has previously been stated in connection with these items.

268. The manner of obtaining the harness and chain drafts for this sample will be shown briefly and the student's attention drawn to a few points which were not mentioned in Part I.

269. It will be found to be a comparatively easy matter to make harness and chain drafts from the weave, but when working these out, regard should always be had to the *best* manner of weaving the cloth.

270. Thus by referring to Fig. 32, which shows the weave of the cloth sample, it will be readily seen that there are over twice as many ends of the satin stripe as there are of the plain, and by noticing the cloth it will be seen that they are much more crowded together. In such cases as this it will generally

be found to be the better plan to place these ends on the *front* harnesses.

271. As the ends of the satin weave will take at least five harnesses, since there are five ends working differently, then it may be said that the ends forming the satin stripe, or the last twenty-five ends in Fig. 32 will be placed on the five front harnesses.

272. The reason for placing these ends on the front harnesses is that as there are more of them they are more liable to break during weaving, and it is much easier for a weaver to draw a broken end through a front harness than through a back one.

273. Again there is not as much strain on the ends drawn through the front harnesses as there is on those drawn through the back. Consequently this lessens to a certain degree, the liability of these ends breaking.

274. It has been decided then to place the ends forming the satin on the five front harnesses. The ends forming the plain weave will consequently be drawn through harnesses next to these five.

275. Here again, a point of some importance should be noticed. It will be readily seen that the first twelve ends of Fig. 32 could be drawn through two harnesses, since it is a plain weave and every other end works alike, but it will no doubt be found better to draw the ends through *four* harnesses instead of two, since by this means there will be fewer ends drawn through a harness which will be found to be an advantage in many ways.

276. This draft then, will call for nine harnesses, five for the satin ends and four for the plain. If the loom that this cloth is to be woven in, can not take this number of harnesses, but can take seven, then of course the weave would have to be drafted to seven harnesses, which is the *smallest* number possible for it to be woven on.

277. In very many cases there will be found to be a number of circumstances which will influence the number of harnesses on which to draft a weave. Some of these have already been pointed out here, and many others will be met with in practice, and consequently the student should constantly be looking for new information, especially in a weave room, where there is an opportunity of taking a sample of cloth and finding the *lowest number* of harnesses on which it can be woven and also the *actual number* of harnesses on which it is being made in that room, then if there are any more harnesses being used than the lowest possible number, learn why these extra harnesses are used, or on the other hand, if the weave is drafted to the lowest number of harnesses, learn why it is not necessary to use any extra harnesses.

278. It should be stated here that with many weaves, it will not be possible to learn the exact number of harnesses that it will take by simply glancing at the pick out, but on the other hand it will be necessary for the student to study the *interlacings of each end separately* and learn if it is similar to any other end in the weave.

279. Commencing now with the first end of the pick out, as shown in Fig. 32, this end will be drawn through the sixth harness, the second end through the seventh harness, the third end through the eighth harness, the fourth end through the ninth harness, and then the ends will commence to *repeat*, that is the next end will be drawn through the seventh harness and so on for the first ten ends.

280. Commencing next with the thirteenth end, or the first end of the satin weave, this end will be drawn through the first harness, the fourteenth end through the second harness, the fifteenth end through the third harness, the sixteenth end through the fourth harness, and the seventeenth end through the fifth harness. At this point the ends will be found to commence to *repeat*, that is the eighteenth end will be drawn through the first harness, and so on.

281. In making out a harness draft the student should always seek to have the ends drawn in, in as regular a manner as the weave will permit.

Fig. 33 shows the harness draft complete.

282. By referring to Calculations, Part VII, the student will find that this cloth contains 88 patterns and four dents over. Since this draft shows how the ends *in only one repeat* are drawn in, it will be readily seen that it must be repeated 88 times in order to *draw in all the ends in the warp*.

283. It will also be remembered that the four dents extra were to be used for the plain, therefore the person drawing in the warp will end by drawing in 8 ends of plain after finishing drawing in the 88 repeats.

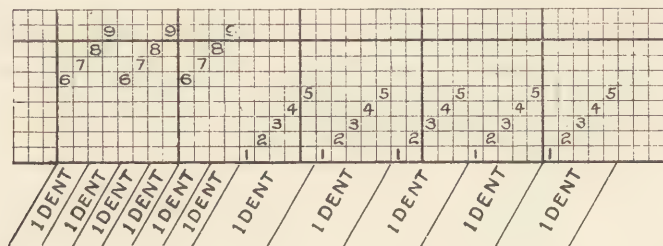


Fig. 33.

284. The short slanting lines below the draft show what ends go together in one dent. It will be seen that this corresponds with the data given in Calculations, Part VII.

285. One point should be noted here. By referring to Fig. 33 the student will see that if, after one repeat has been drawn in, the first end of the second repeat should be drawn through the sixth harness, this would bring the same number of ends on each of the last four harnesses, but for the purpose of illustration suppose there were only 10 ends of plain, then the last end of plain as shown in the drawing in draft, would be drawn through the seventh harness, and if the first end of the

second repeat should be drawn through the sixth harness, this would bring more ends on the sixth and seventh harnesses than on the eighth and ninth, consequently the person drawing in the warp could commence the first end of plain in the second repeat, on the *eighth* harness instead of the sixth. This would give the same effect in the cloth, since the sixth and eighth, also the seventh and ninth harnesses work alike, and it would also give the same number of ends on each harness.

286. As previously mentioned, when making out drafts for any cloths, the student should always seek to obtain the best results that are possible under the circumstances, and with this aim in view should constantly be on the lookout for any little points that will aid in the weaving of the cloth.

287. It is always desirable when making out a harness draft to first make it out in such a manner that it will be as nearly a *straight draw* as possible. This is a great aid to the weaver when drawing in broken ends.

288. Second, try to have as nearly as possible the *same number of ends on each harness*. This is a great aid to the good running of the loom.

289. Third, if it is necessary to have more ends on certain harnesses than on others, *put those harnesses with the most ends at the front of the loom*, unless there is a stronger reason for not doing so.

290. The next item that is necessary in connection with this sample of cloth, is the **chain draft**, and as the method of procuring this from the pick out and harness draft has been fully explained in Part I. of Designing, the different points in connection with this item will be but briefly dealt with here.

291. The chain draft is procured from the harness draft and pick out, consequently it is always necessary to have these two last items before making out the chain draft.

292. By referring to Fig. 33, which shows the harness draft, it will be seen that the first end is drawn through the

sixth harness, therefore the *interlacings of the first end* as shown in the pick out must be the *workings of the sixth harness*, or in other words the interlacings of the first end as shown in the pick out gives the manner of raising and lowering the sixth harness.

293. The second end is drawn through the seventh harness, therefore the *interlacings of the second end* as shown in the pick out gives the *manner of raising and lowering the seventh harness*.

294. The third end is drawn through the eighth harness, and consequently the eighth harness will be raised and lowered as indicated by the third end of the pick out.

295. The fourth end is drawn through the ninth harness, and this harness as shown in the chain draft will be the same as the fourth end as shown in the pick out.

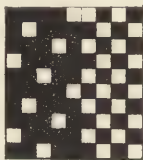


Fig. 34.

296. The fifth end is drawn through the sixth harness, but since the working of this harness has already been obtained, nothing more needs to be done with this.

297. The same is true of all the ends until the thirteenth is reached, which is drawn through the first harness, consequently the *interlacing of the thirteenth end* as shown in the pick out will give the *workings of the first harness*.

298. For the same reason the second harness will work like the fourteenth end of the pick out, the third harness will work like the fifteenth end of the pick out, the fourth harness like the sixteenth end, and the fifth harness like the seventeenth end.

299. This will complete the chain draft since the manner of raising and lowering all the harnesses has now been learned.

Fig. 34 shows the completed chain draft as made from the harness draft Fig. 33 and the pick out Fig. 32.

300. The list of items which were mentioned in Clause 182 as being necessary to obtain, when desiring to reproduce any sample of cloth, have now been fully explained, but as previously mentioned there are a few other items which are requisite, but which it will not be necessary for the student to send in with the samples which he will receive with these lessons. These items will be explained here, and are as follows:

- 1st. Determination of face and back of fabric.
- 2d. Determination of warp and filling.
- 3d. Finding the percentage of contraction in the length of the warp during weaving.
- 4th. The number of beams necessary to place the warp yarn upon.
- 5th. The raw material.
- 6th. The number of heddles on each harness.

301. As previously explained, when desiring to find the pick-out of a sample of cloth it is always necessary to first determine which is the face and which is the back, in order that the results obtained may be accurate for reproducing the cloth. After the student has had some experience in this connection it will be comparatively easy to readily tell which is the face and which is the back of the cloth. The face of a cotton fabric will generally be found to show a much clearer and better design than the back. If the cloth is a single fabric the face will generally be found to have a smoother feeling.

302. By noticing the cloth sample which has been dealt with in this lesson it will be seen that the satin stripe on one side of the cloth shows up much more prominently than it does on the other side. The side which shows the design more prominently is the face. This will be found to be true in almost every case.

303. When the fabric is a backed or double cloth, the face can be readily distinguished from the back by means of the style of the cloth or the finish. When dealing with warp backed fabrics the face can readily be distinguished from the back, since in this case there will be found to be ends floating for some distance at the back. Double and backed cloths will be fully dealt with in a future lesson, and from the explanation given the student will readily understand the points mentioned.

304. There are several methods by which the warp may be determined from the filling. If the sample submitted for analysis contains a part of the selvedge, the warp can readily be distinguished from the filling since the *selvedge ends always run in the direction of the warp*. As previously explained in Part VII. of Calculations, the selvedge, or list of the fabric, consists of a number of ends placed on both sides of the warp. In many cases the body of the cloth will be found to be woven from single yarn, while the selvedge is woven from 2 ply or double yarn.

305. If the yarns in one system are harder twisted, or have more turns per inch than those in the other, the harder twisted yarns are generally the warp yarns.

If the sample of cloth has what is called a face finish or nap, the direction of the nap indicates the warp, since these cloths have passed through the machine in the direction of the warp.

The counts or numbers of the yarn used in each system will often assist in indicating which is the warp and which is the filling, since in many cases the warp yarns will be found to be of coarser counts than the filling.

306. If in any case one series of yarn is found to be of different materials, such as cotton and wool, or cotton and silk, while the other series of yarn is found to be of one system, the series of yarns which are of different systems are generally the warp yarns, although this is not an invariable rule.

If one system of yarns is found to have been sized and the other not, the former is the warp. This is difficult to distinguish after the cloth has been finished, but is a good test for brown cotton goods.

307. If the sample contains reed marks, these marks will indicate the warp, since they always run warp-ways. These are marks caused by the reed wires getting out of place, thereby crowding together some of the ends near them and allowing others too much space.

In any fabric of a striped character or checked effect, in which one direction of the lines is prominent compared with the others, the direction of the stripes or the prominent lines in the check indicate the direction of the warp.

308. The twill, if the design is a twill, generally runs up diagonally from the left to the right, so that if the face of the warp is ascertained it will be readily seen which is warp and which is filling.

309. If one series of yarns is ply and the other single the ply yarns are generally the warp.

In cases like the sample of cloth included with this lesson, the stripes always run warp-ways.

310. In making out an order for the amount of warp yarn to be run through the slasher for any warp beam, it will be found necessary to learn the probable percentage of contraction which will take place during weaving. For instance, if it is desired to produce say 500 yards of cloth from warp on one loom beam, it will readily be seen that a somewhat larger number of yards of warp yarn will have to be placed on the beam, owing to the contraction which will take place during weaving.

311. The manner of ascertaining the contraction of any cloth during weaving has been dealt with fully in Part VII. of Calculations and consequently will not need any further explanation here. However, it should be borne in mind by the

student that no hard and fast rules can be laid down for contraction of warp yarns, as this is largely a matter of experience, since some weaves take up much more than others during weaving. The *kind of weave*, the *counts of the warp and filling* and the *number of picks per inch* are the general circumstances that regulate the take up of the warp, and these should be always carefully considered when desiring to learn the number of yards of warp to weave a certain number of yards of cloth.

312. In very many cases, when desiring to reproduce a sample of cloth, it will be found necessary to place the yarns on different beams. In some cases as high as four separate beams are used. For instance, in cases where a weave which interlaces only once in six or eight picks is combined with plain cloth, it will be readily seen that the part of the warp yarn which forms the plain weave will take up much more than will the other.

313. In such a case it would be found necessary to place those ends which form the plain weave on an entirely separate beam, since if this was not done the ends of the plain weave contracting so much more than would the other ends, would cause the latter to work slack and thus cause a defective cloth. When dissecting any cloth and weave to determine this item the student should always carefully consider the different weaves in the cloth.

314. It will be readily understood that if the cloth is made entirely from one weave, it will simply be necessary to use one beam, but in cases where the cloth is woven with separate weaves it will be necessary for the student to study these weaves carefully and ascertain whether one will take up more than the other.

315. When desiring to learn the number of beams necessary to weave any sample of cloth, the most essential point to notice is the number of interlacings which each weave makes in a certain space. For instance, the ends of one weave may

interlace with the filling six times in a certain number of picks, while the ends of another weave may interlace twelve times in the same number of picks. When such is the case it will be readily seen that the ends interlacing the larger number of times will take up much more than will the others, on account of their having to bend around the filling much more frequently. Consequently it will be found best in such instances to place the two systems of yarns on separate beams.

316. In many fabrics that the student will meet with, there will be found to be a mixture of different materials. For instance, cotton and woollen yarns are often used in the same fabrics, as well as cotton and silk. In such cases it will be found necessary to determine which ends are of one material and which are of another.

317. A knowledge of the different fibres is a great aid in determining the different materials in such cases, but sometimes it will be found necessary to make chemical tests. This is especially necessary when determining the *percentage* of the material in fancy threads such as cotton and wool or cotton and silk mixed together, or to determine the proportions of each material in a yarn made from two or more different raw stocks. A few suggestions will be given here which will be of great aid to the student in making such tests.

318. The readiest method of ascertaining the difference between animal and vegetable fibres is to burn some of the yarn. Vegetable fibres are composed of carbon, hydrogen and oxygen, and when burned will make a flame, emit no odor and leave an ash. Animal fibres are composed of the same elements together with nitrogen and when burned will not flame, but smoulder, coiling and forming a small crisp bunch. The animal fibres are also distinguished by a peculiar odor which is similar to burned horn or feathers.

319. The preceding tests are not always found to meet the requirements and the following tests may then be used.

When a sample of yarn or cloth is to be tested, it should first be thoroughly washed, so as to remove any sizing or foreign matter that may exist. Afterwards dry it thoroughly and weigh it, if the percentage of each kind of material is desired.

320. The following tests will be found to cover the separation of silk, (raw and wild), cotton, wool, or linen, that may be combined in one yarn or cloth.

321. To separate cotton and wool, (cotton remaining,) clean and weigh, then boil the sample gently for two hours in 8° B. caustic potash, then wash and dry. During the boiling, a few drops of water are added from time to time to prevent the alkali from becoming too concentrated. After drying at 100° C, (212° F.), the residue is weighed, giving the weight of cotton; the loss being the weight of the wool. Instead of potash, 7° B. (specific gravity 1.05) caustic soda may be used, boiling for one quarter of an hour.

322. 100° C, or Centigrade, corresponds to 212° Fahrenheit. B. means Baumé, and refers to the graduated scale on Baumé's hydrometer, used for determining the specific gravity of a solution.

323. To separate wool and cotton, (wool remaining) immerse the sample in ammoniacal copper oxide for 20 minutes, after which add water to the solution, then filter and wash, dry and weigh the residue; the weight will be the amount of wool in the mixture.

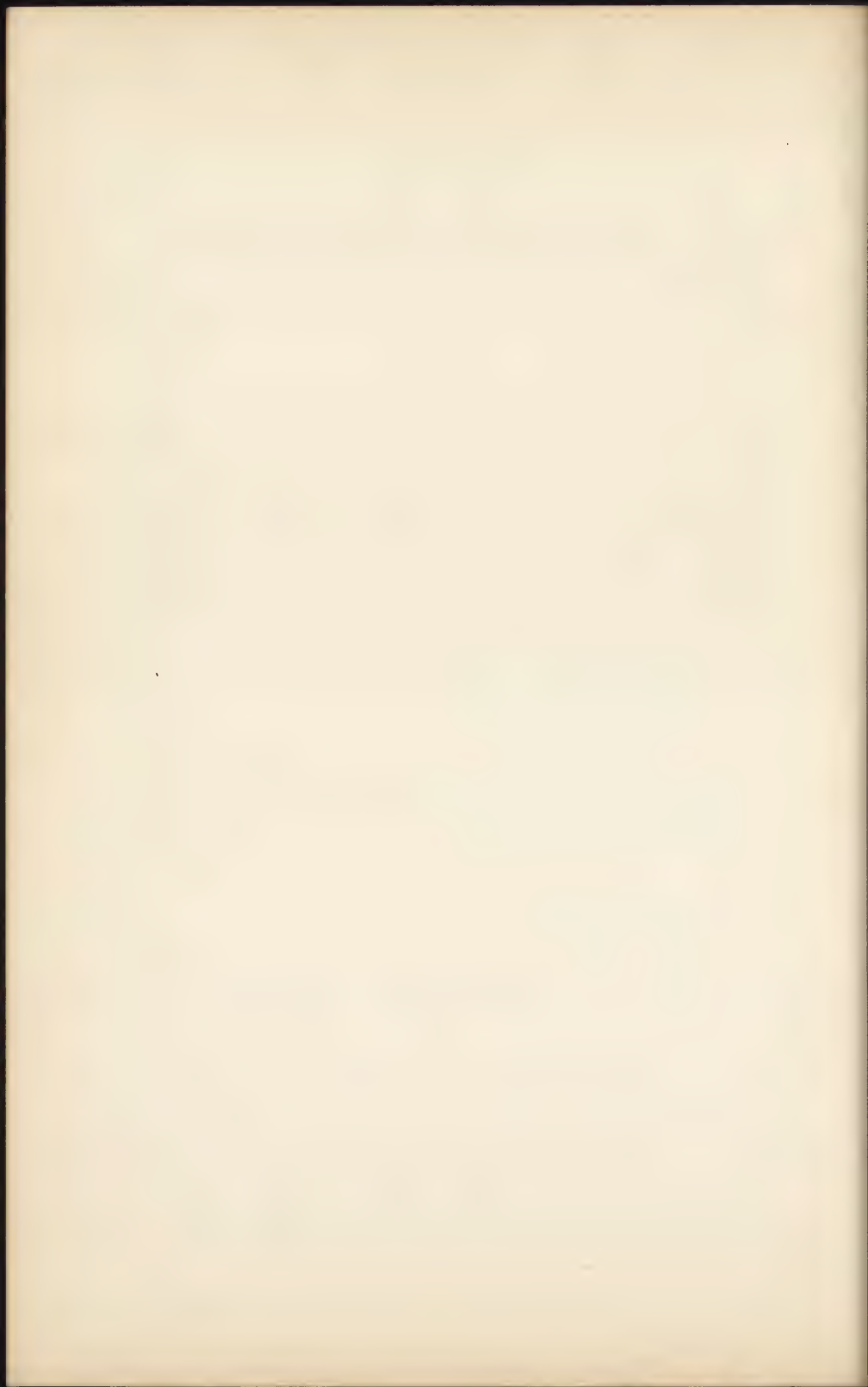
324. To separate silk, cotton and wool. (Remont)

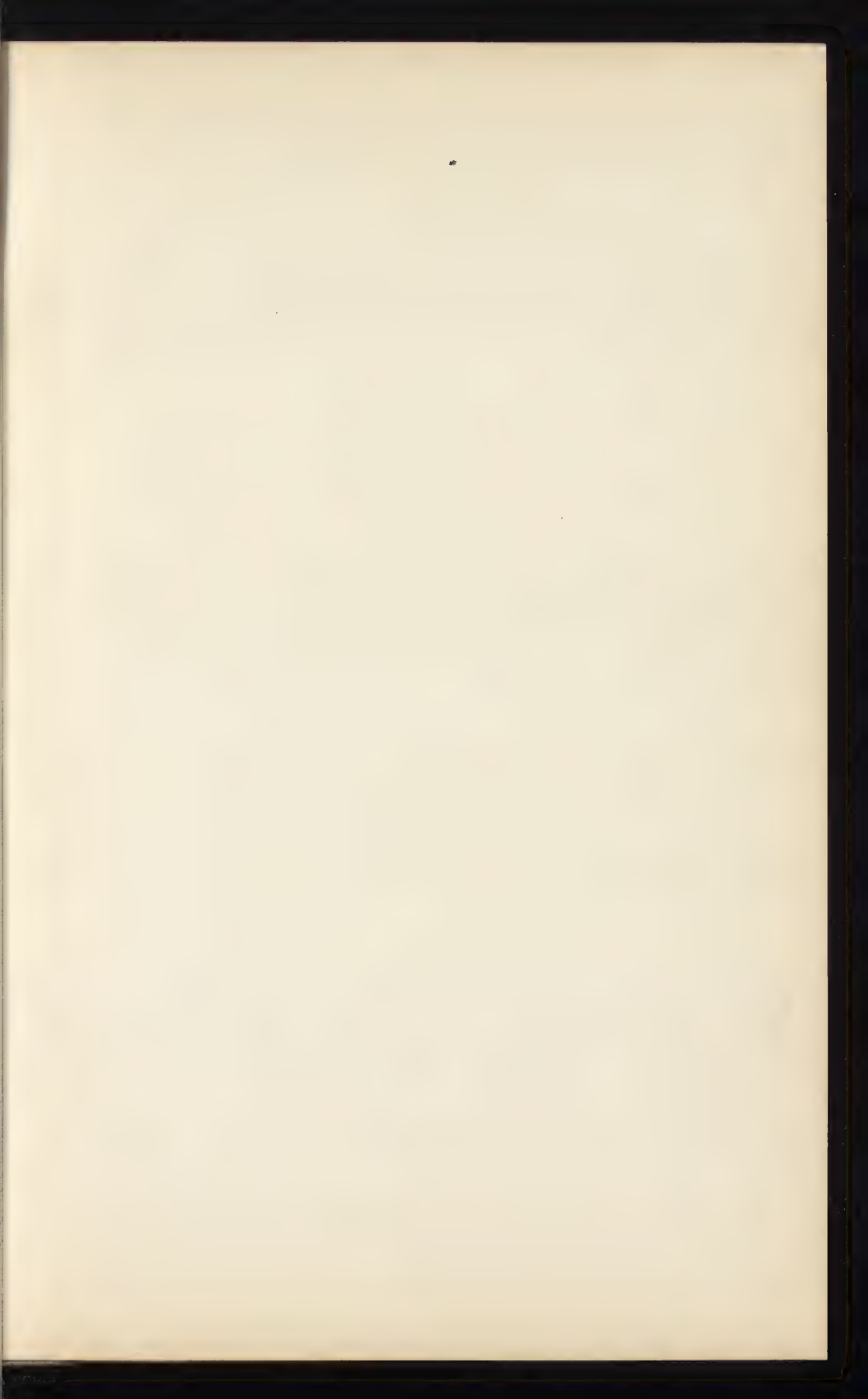
Take 2 samples of yarn, each of the same weight, boil them from a quarter to half an hour in 200 c. c. of 3° B. hydrochloric acid, to remove the sizing, etc., then wash them. Immerse one sample in a boiling solution of basic zinc chloride for a short time, then wash thoroughly, first in acidified and then in clean water, then dry it; the loss in weight gives the amount of silk.

325. Boil the second sample for 15 minutes in 60 to 80 c. c. of caustic soda, (sp. gr. 1.02), and then wash and dry it. The residue is cotton, to the dry weight of which must be added about 5% to compensate for the loss of the fibre during the operation, the difference between this and the original weight representing the weight of wool.

326. To arrange the fabric to be tested, and ascertain the various percentages of each fibre composing the cloth or yarn, weigh the yarn or cloth very carefully and make a memorandum of its weight; then test the sample by the test best adapted to the material, and dry the remaining fibre. Weigh the latter after thoroughly drying, and deduct the weight from the gross weight previously obtained. The remainder will represent the amount dissolved.

327. The method of determining the number of heddles which should be placed on each harness in order to reproduce a sample of cloth has been fully dealt with in Part VII. of Calculations. The student should carefully review this item and become thoroughly familiar with it in order that no difficulty will be met with when desiring to determine this particular for any sample of cloth which it may be necessary to dissect.







TWILLS AND DERIVATIVES.

328. If different cloths are carefully studied, it will be found that there are certain classes of weaves which are met with more commonly than others. Thus, one of these weaves is the plain weave, which is illustrated in the plain cloth sample, and which has been fully described.

329. Another class of weaves which is very commonly met with comes under the head of **twills**, and this lesson is intended to deal with twills and certain weaves derived from them.

330. The student should thoroughly understand that, in designing, there are a few certain weaves which may be said to be **fundamental weaves**, and that all other weaves are derived from these. Weaves thus obtained are known as **derivatives**, and although, as just stated, the number of fundamental weaves is small, yet the weaves which may be derived from them are innumerable.

331. *Regular twill* weaves may be said to belong to the fundamental class of weaves, and the student should thoroughly understand the method of marking out a twill on design paper before attempting weaves derived from them.

332. A twill weave is one in which lines of warp and filling run across the cloth *diagonally*. It will be remembered that with the plain weave the warp end on one pick was over the filling and on the next was under the filling, and that this order was carried out throughout the warp.

333. In a twill, however, each warp end must be either down or up for at least *two picks in succession* in order to make

the twill line across the cloth. On this account the student will readily understand that *at least three harnesses must be used when weaving a twill*, or, in other words, three harnesses is the smallest number on which a twill can be woven.

334. Fig. 35 will serve to illustrate this simplest twill. It will be noticed that the first end is down on the first pick, the second end is down on the second pick, and the third end is down on the third pick.

335. This shows one repeat of the weave, that is, if the fourth end was shown, it would be found to be similar to the first end, the fifth end would be similar to the second end, and so on. In other words this weave is complete on 3 ends and 3 picks, or 3×3 . The student should carefully refer again to what was said in Part I. in regard to the repeat of a weave, as this becomes a very important matter when dealing with twills.

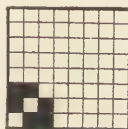


Fig. 35.

336. Referring again to Fig. 35, the student will notice that, as shown on design paper, a diagonal line is formed running from left to right. This design would give the same effect in the cloth.

337. It should be stated here that twills may run *either from left to right, or from right to left*, although they are usually made to run from left to right.

338. One of the most important things in designing, for the student to understand, and also probably one of the hardest, is the *repeat of the weave*. As just stated, this is dealt with in Part I. of Designing, but as it becomes an especially important matter when dealing with twills, it will not be out of place to speak of this subject again.

339. The student will find it to be a great aid, when only one repeat of a weave is given, to practice extending the weave on design paper for several repeats. By this means one repeat of any weave will more readily be found, when it becomes necessary to distinguish a single repeat from several repeats.

340. Weaves may be repeated on design paper either in their *ends*, or in their *picks*, or they may be repeated in *both ends and picks*.

341. Suppose for an example it is desired to extend Fig. 35 for 3 repeats in its ends. As already stated, this weave is complete on 3 ends, consequently 3 repeats would occupy 3 times this number, or 9 ends.

342. If it was desired to repeat the weave in its picks 3 times, it would occupy 9 picks, while if it was repeated 3 times in ends and picks both, it would occupy 9 ends and 9 picks.

343. When repeating a weave, it is simply necessary to copy the weave exactly as it is, that is, if Fig. 35 was to be repeated in its ends, the weave, as shown, would first be set down. This would occupy 3 ends.

344. The fourth end would be the same as the first end, the fifth end the same as the second end, and the sixth end the same as the third end. This would make two repeats. If another repeat was required, then the ends would simply be copied again in their order.

345. If the weave was to be repeated in its picks, then the picks would be copied in the same manner as were the ends when repeating in its ends.

346. A, in Fig. 36, shows the weave Fig. 35 repeated 3 times in its ends. If the student examines this figure it will be noticed that the ends repeat as previously explained.

347 B, shows this weave repeated in its picks, and it will be seen in this figure that the picks are copied instead of the ends as was the case in Fig. 36A.

C, shows the weave repeated in both ends and picks.

348. Twills are said to be **equally flush, warp flush** and **filling flush**, according to the relative amount of warp and filling that shows on the face of the cloth.

349. Thus, if a twill weave brings the *same* amount of warp to the face of the cloth that it does filling, it is said to be an *equally flush twill*. If there is more warp than filling on the face it is said to be a *warp flush twill*, while if the *filling predominates*, it is a *filling flush twill*.

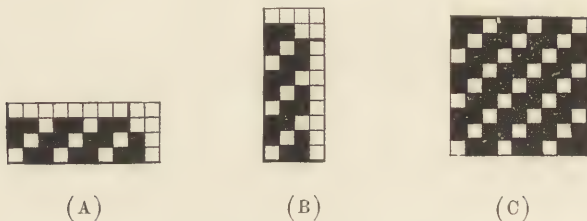


Fig. 36.

350. From this explanation the student will readily understand that the 3 end twill previously shown, is a warp flush twill. The filling flush 3 end twill is shown in Fig. 37.

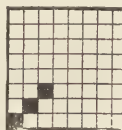


Fig. 37.

351. Regular twills are those which run in regular order; that is, *if an end is raised on a certain pick, then on the next pick the end next to this one will be raised*, and this method is continued until the twill repeats. On this account it is simply necessary to know the *interlacing of any one end or pick in the weave in order to show the entire weave on design paper*.

352. The interlacing of the first end or pick of any regular twill is generally shown by writing numbers above and below a horizontal line. Thus, for example, $\frac{2}{3} \frac{1}{2}$ would show that the *first end* is up 2 picks, down 3, up 1 and down 2.

353. As previously stated this also shows the interlacing of the *first pick*, since it shows that on the first pick, the first 2 ends are up, the next 3 are down, the next 1 is up and the next 2 are down.

354. By adding these numbers together it will be seen that their sum is eight. This brings up another point, which is that the **base** of a regular twill, as this representation is called, shows also *how many ends and picks the twill is complete on*. Thus, in this case, since these numbers added together make eight, the twill must consequently be complete on 8 ends and 8 picks, or 8×8 .

355. Suppose it is desired to work out the twill with the base $\frac{2}{3} \frac{1}{2}$.

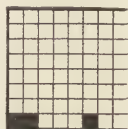


Fig. 38.

The first step will be to mark the first end or first pick in the manner indicated by the base. As previously stated either the first end or first pick may be marked and in either case the twill will be the same. One method, however, should be adopted and in these lessons the system of marking the first pick will be used.

356. It therefore is necessary to mark the first pick in the manner indicated by the base which, as previously stated, shows that the first 2 ends are up, the next 3 down, the next 1 up and the next 2 down.

357. Fig. 38 shows the first pick marked in this manner, and if the student follows each mark carefully it will readily be seen that the ends will be raised in the manner indicated.

358. The next step will be to *run the twill up in regular order*. This is done after the manner previously stated, that is, *if an end is up on one pick, on the next pick the next end is up*.

359. That the student may more readily understand this method of making a twill, each separate end will be run up, and afterwards the complete design will be shown. Commencing then with the first end, and the first pick, which, as previously explained, is at the *lower left hand corner*, it will be seen that this first end is raised on the first pick, then consequently on the *next pick the next end to the right will be raised*, that is, if the twill is running to the *right*, then the second end will be raised on the second pick, and since the second end is raised on the second pick, the third end will be raised on the third pick. This is continued for the 8 ends and 8 picks, and will result as shown in Fig. 39.

360. Next taking the second end and dealing with it in exactly the same manner, it will result as shown in Fig. 40.

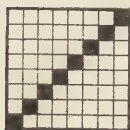


Fig. 39.

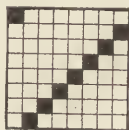


Fig. 40.

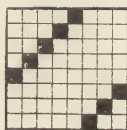


Fig. 41.

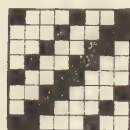


Fig. 42.

361. One particular point, however, should be noted in connection with this figure. It will be noticed that when running these marks up on the design paper, the *eighth* end is raised on the *seventh* pick. If this was continued in a regular line for the eight picks, the next mark would come on the *ninth* end, but it will be remembered that the weave is complete on eight ends, consequently to overcome this difficulty the mark for the *ninth* pick is placed on the *first* end, since the *first* and *ninth* ends of the weave will be exactly alike. This method is clearly shown in Fig. 40.

362. That this is correct will be readily seen if the student will simply make two repeats of the ends of this weave.

363. Referring now to Fig. 38 it will be seen that the third, fourth and fifth ends are lowered on the first pick and these

blanks would consequently run up in the same manner as the filled in squares. It may be stated here that when making a twill weave from a base, it is not necessary to consider the blanks, since these must necessarily be right, if the filled in squares are run up correctly.

364. Considering next the sixth end in Fig. 38, it will be seen that this end is raised on the first pick, consequently the seventh end will be raised on the second pick, and so on. This is shown in Fig. 41.

365. It should again be noted in connection with this figure that the *eighth end* is raised on the *third pick*, and in order to continue for the eight picks, the *first end must be raised on the next pick*, and from this point the marks are run to complete the eight picks. This is clearly shown in Fig. 41.

366. It will be seen that the seventh and eighth ends are down on the first pick and consequently it is not necessary to consider these.

367. Next, combining Figs. 39, 40 and 41, the complete twill will be obtained, which is shown in Fig. 42.

Thus, it must be said that the twill weave, Fig. 42, is derived from the base, Fig. 38.

368. A rule for making any regular twill when the interlacings of the first pick are given may be stated as follows :

Rule. *Mark on the first pick in the design, the ends that are to be lifted on that pick ; then above, on the second pick, place similar marks, moving them one square to the right, if the twill is to run to the right, or one square to the left, if the twill is to run to the left. Proceed with each pick in the same way, moving one to the right or left, as the case may be, until there are as many picks as ends, when the design will be completed.*

369. Another point which should be noted by the student when studying twills, is the **angle** which the twill will make in the cloth.

370. The angle of a twill may be effected in two ways. First, by the *manner in which the weave is placed on the design paper*, and secondly by the *relative number of ends and picks per inch*.

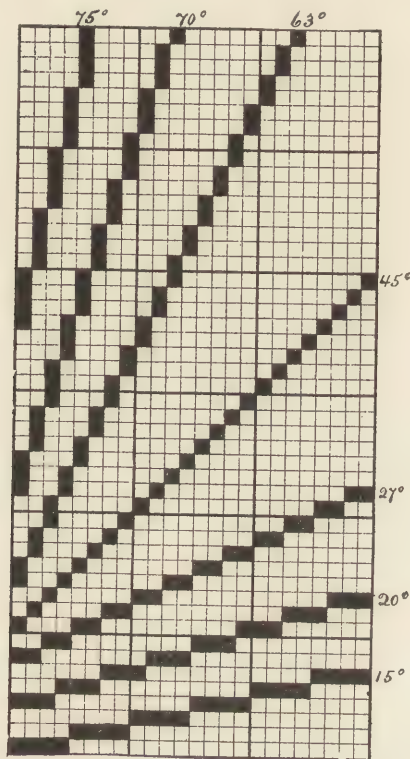


Fig. 43.

371. Dealing first with the different angles which may be placed on design paper, Fig. 43 will serve to illustrate this point. By studying this figure the student will notice that different angles are formed by means of *running the dots up differently*.

372. Beginning with the first twill at the bottom, it will be seen that the dots move *four squares filling way*, or across

the design, and then *one square up*. By this means an angle of 15 degrees is formed. In the next case the dots move *three squares filling way* and then *one warp way*. By this means an angle of 20 degrees is formed. In the next case the dots move *two squares filling way*, and then *one warp way*, which gives an angle of 27 degrees.

373. By carefully noting each of these different lines of twills, the student will readily understand the method of forming different angles.

Twills are spoken of as being such a degree twill, the 45° twill being the most common.

374. Considering next the method of changing the angle of a twill by means of the relative number of ends and picks per inch, it should be stated that a twill which forms a certain angle on regular 8×8 design paper, will not form that same angle in the cloth, *unless the number of ends and picks per inch are the same*.

375. Take for example, the 45° twill shown in Fig. 44, it will be seen that this twill is shown on 8×8 design paper, that is, the design paper has 8 rows of squares horizontally and 8 rows of squares vertically between the heavy lines, or in the same space.

376. Since a row of squares across the paper represents a pick, and a row of squares vertically represents a warp end, it will be seen that a twill, or any design on this kind of design paper, shows the weave as it would appear in the cloth if the *same number of ends per inch, as picks per inch, are placed in the cloth*.

377. Suppose that twice as many picks are placed in one inch of the cloth as there are ends per inch, then in order to give a correct imitation of this on design paper, a paper should be used which contains twice as many horizontal rows of squares in a given space, as it has vertical rows of squares.

378. Fig. 45 shows the twill in Fig. 44, on design paper of this kind, and it will be noticed that an angle of 27° is formed in this manner.

379. On the other hand if there are twice as many ends per inch in the cloth as there are picks, an angle of 63° would be formed with this same twill. Fig. 46 will serve to illustrate this point.

380. When working out twill weaves on design paper, it should be distinctly understood that whatever kind of twill the weave may be, the marks or blanks, *for one repeat*, should not be extended beyond that number of ends and picks which has previously been decided upon.

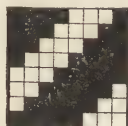


Fig. 44.



Fig. 45.

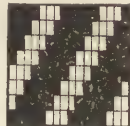


Fig. 46.

381. For instance, if one repeat of the weave occupies four ends and four picks, then the fifth end would be like the first and so on. Also the fifth pick would be like the first pick, and so on, and consequently to show one repeat only four ends and four picks are necessary.

382. *All regular 45° twills repeat on the same number of picks as ends*, so that if the base of such a twill occupies, say twelve ends, the student may know that it repeats on twelve ends and twelve picks.

383. A few regular 45° twills are given here, and by studying these carefully, together with the explanations previously given, the student should have a good understanding of the method of working out twills.

384. Fig. 47 is a regular 45° twill, with the base $\frac{5}{3} \frac{2}{3}$, twilled to the right.

Fig. 48 is a regular 45° twill, with the base $\frac{4}{2} \frac{1}{2} \frac{2}{3}$, twilled to the right.

Fig. 49 is a regular 45° twill, with the base $\frac{1}{5} \frac{1}{4} \frac{6}{3}$, twilled to the left.

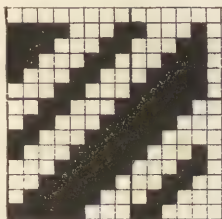


Fig. 47.

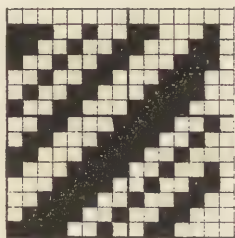


Fig. 48.

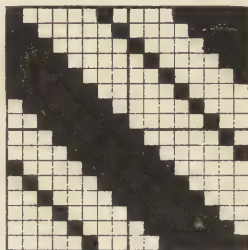


Fig. 49.

385. There are several twills which are constantly being met with in cloths and which are known by some definite name. It may be as well to give these here, in order that the student, when hearing them spoken of, may recognize them.

PRUNELLE TWILL		Cassimere	CROW		ALBERT	
Filling	Warp	Twill	Filling	Warp	Filling	Warp

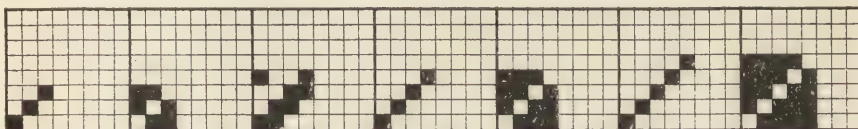


Fig. 50.

386. These are the **Prunelle**, both warp and filling flush; the **Cassimere**, which is equally flush; the **Crow**, both warp and filling flush; and the **Albert** twill, both warp and filling flush. These different weaves are shown in Fig. 50.

387. In addition to these there are also the **Broken Crow** weave, both warp and filling flush, the **Five end Venetian**, and the **Mayo** or **Campbell** weaves. These are shown in Fig. 51.

388. The weaves shown in Fig. 51 are not regular twill weaves, but are weaves so well known that it was considered best to insert them here.

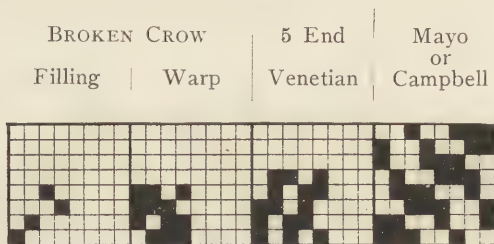


Fig. 51.

EXAMPLES FOR PRACTICE.

389. 1. A regular 45° twill is arranged $\frac{2}{1} \frac{1}{2} \frac{3}{1}$. Complete the weave.

2. State what angle the above twill would form in the cloth if woven with 54 ends and 27 picks per inch, using the same counts of warp and filling.

3. Show two repeats in both ends and picks of a regular 45° twill, having the first pick arranged $\frac{3}{3} \frac{1}{1}$.

4. State what angle the twill as given in answer to question 3, would form in the cloth, if woven with 30 ends and 60 picks per inch, using the same counts of warp and filling.

390. As was stated at the beginning of this lesson, the number of what may be termed fundamental weaves is comparatively small, but the weaves that may be derived from them are innumerable. Thus, if a simple twill weave is shown on design paper, several other weaves may be obtained from it, by *re-arranging* either the ends or picks. Designs thus obtained are termed **derivatives**.

391. To illustrate this point, a regular 45° twill, which is shown in Fig. 52, will be taken, and three other weaves formed from it.

392. In the first case it will be assumed that it is desired to form another weave by re-arranging the ends, and it will be assumed that the re-arrangement is to be 1, 4, 7, 2, 5, 8, 3, 6.

393. *By this, it is meant that the*

1st end of the new weave is to be like the 1st end of Fig 52

2d " " " " " " " " " " 4th " " " "

3d " " " " " " " " " " 7th " " " "

4th " " " " " " " " " " 2d " " " "

5th " " " " " " " " " " 5th " " " "

6th " " " " " " " " " " 8th " " " "

7th " " " " " " " " " " 3d " " " "

8th " " " " " " " " " " 6th " " " "

394. It will be seen that, commencing with the 1st end of Fig. 52, every *third* end is taken until, by this method, the 1st end is reached again, when the design commences to *repeat*.

395. Fig. 53 shows the twill, Fig. 52, re-arranged in this order, and it will readily be seen that an entirely different weave is obtained.

The student should study this weave carefully, together with the explanation just given.

396. Suppose that it is again desired to re-arrange the twill, Fig. 52, in its ends, the re-arrangement in this case to be 1, 2, 5, 6, 3, 4, 7, 8.

397. Fig. 54 shows the twill, Fig. 52, re-arranged in this manner, and by carefully studying these two figures the student will readily see that the

1st end of Fig. 54 is like the 1st end of Fig. 52

2d " " " " " " " " 2d " " " "

3d " " " " " " " " 5th " " " "

4th " " " " " " " " 6th " " " "

5th " " " " " " " " 3d " " " "

6th " " " " " " " " 4th " " " "

7th " " " " " " " " 7th " " " "

8th " " " " " " " " 8th " " " "

398. From these two examples, the student will readily understand that many weaves can easily be obtained from a regular twill weave, or in fact from any weave, since after deriving a weave from a twill, other weaves may be obtained from this derivative *by re-arranging the ends of the derivative*.

399. When a weave is to be re-arranged in its *picks*, the same process is employed as was illustrated when re-arranging the ends, with the exception, of course, that in this case the picks, instead of the ends, are changed.

400. Suppose, for an example, it is desired to re-arrange the picks of Fig. 52 by taking the first three picks, missing the next three, taking the next three, and so on, until the weave repeats.

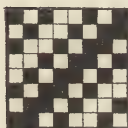


Fig. 52.



Fig. 53.

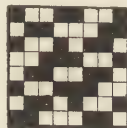


Fig. 54.

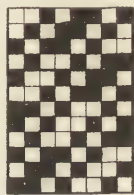


Fig. 55.

401. Fig. 55 shows the twill, Fig. 52, re-arranged in this manner, and by carefully comparing these two figures the student will readily see that the first three picks of Fig. 52 are copied for the first three picks of Fig. 55; that the next three picks of Fig. 52 are skipped, but that the next three, that is, the 7th, 8th and 1st, are copied for the 4th, 5th and 6th picks of Fig. 55, and that this method is continued until the weave *repeats*.

402. In re-arranging any weave in either its ends or picks, the *repeat* becomes an important matter and should always be carefully considered by the student.

403. Take for example Fig. 55. It will be noticed that the 1st pick of this figure is like the 1st pick of Fig. 52, and

also that in working out this new weave, the 6th pick of Fig. 55 will be the same as the 1st pick, but the weave does not repeat on this pick, since the next pick, the 7th, is not like the second pick.

404. However, after working out twelve picks in this manner, it will be noticed that the weave repeats, since the next, or 13th pick would be like the 1st; the 14th like the 2d; the 15th like the 3d, and so on.

405. In selecting an order, by which to re-arrange either the ends or picks of a weave, the student should be careful to select one which will cause the weave to repeat.

406. For an example, suppose that it was attempted to re-arrange the ends of an eight end twill by moving in two, that is, taking one and skipping one. It will be seen that the order would be 1, 3, 5, 7, when it would come back to 1 again and continue in the same order. This, of course, would be a repeat in a certain sense of the word, but would not be a *repeat of the weave*, since all of the ends of the original weave are not used.

407. When it is desired to learn in what order the ends may be taken to make the weave repeat, when re-arranging the ends or picks of a weave, by means of taking one end, and skipping a certain number, *find two numbers, which added together, will equal the number of ends or picks the weave is complete on, but which can not be divided into each other, or into the number of ends or picks of the weave without a remainder.*

408. Suppose, for an example, it is desired to re-arrange the ends of a twill which is complete on 12×12 . It will be seen that 7 and 5 are two numbers which can not be divided into each other, or into twelve without a remainder, but which added together will equal twelve.

409. Therefore the ends of the weave may be re-arranged by moving in sevens, or fives. That is, if the ends were arranged on a base of seven, the first end of the weave would be copied, the next six would be missed, and so on, which would give the

following order: 1, 8, 3, 10, 5, 12, 7, 2, 9, 4, 11, 6. Here the weave would commence to repeat and consequently would not need to be continued.

410. On the other hand, suppose that two other numbers, such as eight and four, are taken. It will be seen that these two numbers added together make twelve, and it will also be noticed that four can be divided into eight and also into twelve. It would not, therefore, be possible to re-arrange a twelve end twill with either of these numbers.

411. To show that this is correct, suppose that it is attempted to re-arrange the ends on a basis of four, that is, taking the first end and missing the next three. The order would be as follows: 1, 5, 9, and if the next three ends are missed it will be seen that it is necessary to take the 1st end again, when the same ends will be taken right over, and consequently only these three will be used *which will not give a repeat of the weave*.

412. When twills are re-arranged in this manner they are said to be re-arranged in **satin** order. Satin weaves are explained in the next lesson.

413. Another method of obtaining new weaves, and one quite generally adopted is that of taking two weaves and **combining** them, either in their ends or picks.

414. Suppose, for an example, that the two weaves shown in Figs. 56 and 57 are given, from which it is desired to form a new weave by means of combining them pick and pick, that is, first taking a pick of one weave and then a pick of the other.

415. Fig. 58 shows a weave made in this manner. The student should carefully study these three figures and note how Fig. 58 is obtained from Figs. 56 and 57. It will be noticed that the

1st pick of Fig. 58 is the 1st pick of Fig. 56
2d " " " " " " 1st " " " 57
3d " " " " " " 2d " " " 56
4th " " " " " " 2d " " " 57

This is continued until the picks in both Figs. 56 and 57 are used, when the weave will commence to repeat.

416. There are numerous other weaves which may be obtained by combining these two weaves pick and pick.

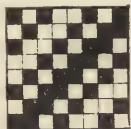


Fig. 56.

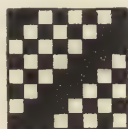


Fig. 57.

Take, for example, Fig. 59, which is different from the weave shown in Fig. 58 and yet is obtained by combining Figs. 56 and 57 pick and pick.

417. By carefully noticing Fig. 59 it will be seen that in this case, Fig. 57 is *commenced on the second pick* instead of the first, as was the case with Fig. 58. Thus, the

1st pick of Fig. 59 is the 1st pick of Fig. 56	
2d " " " " " " 2d " " " 57	
3d " " " " " " 2d " " " 56	
4th " " " " " " 3d " " " 57	

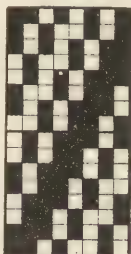


Fig. 58.



Fig. 59.

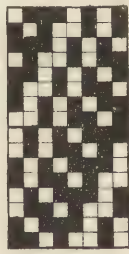


Fig. 60.

and this is continued until all the picks in both weaves are used when the new design will commence to repeat.

418. Still another weave may be obtained by commencing with the first pick of Fig. 56, but having for the *second* pick of the new weave, the *third* pick of Fig. 57.

419. Fig. 60 shows such a weave, and by carefully studying each pick the student will notice that the

1st pick of Fig. 60 is the 1st pick of Fig. 56

2d " " " " " " 3d " " " 57

3d " " " " " " 2d " " " 56

4th " " " " " " 4th " " " 57

5th " " " " " " 3d " " " 56

6th " " " " " " 5th " " " 57

and so on, until all of the picks in both Figs. 56 and 57 are used when the weave commences to repeat.

420. In addition to combining weaves pick and pick, they may also be combined by taking *two picks* of one weave and then *one pick* of the other, or by taking *two picks* of one weave and *two picks* of the other, or in short, almost any method may be adopted, and consequently the student will readily see that the number of weaves which may be obtained is almost without a limit.

421. However, when combining weaves in this manner, care should be taken to put together only such weaves as will make uniform cloths, that is, cloths in which every end will take up evenly in weaving.

422. Again, weaves should be combined in such a manner that long floats will be avoided. If the student will practice combining different weaves, it will be readily seen that frequently when two weaves are combined by one method, long floats will appear, but by starting on a *different pick*, or by using a *different method* of combination, the same two weaves may be combined without this defect.

423. When combining, or copying twills, the natural tendency of one just learning designing, is to look from the designs to be copied to the design being made.

This method occupies considerable time and is not very satisfactory to the student. A better method is to mark the *first pick* of the twill and then *run it up in the manner explained in connection with regular twills*.

424. When two twills are to be combined in their picks, it is a good plan to mark on the design paper just which row of squares each twill is to occupy, and then run the twills up separately, placing first one twill on its rows of squares and then the other twill on its rows.

425. Another question arises here, and one which the student should note carefully. It will be noticed that the two weaves, which so far have been combined, are complete on the same number of ends and picks. It frequently occurs, however, that weaves are combined which are not complete on the same number of ends and picks, and in such cases it becomes an important matter to learn when the weave, formed by the combination, commences to repeat.

426. To illustrate this point, suppose that it is desired to combine, pick and pick, an 8×8 twill with a 6×6 twill. It will be readily seen that when the eight picks of the first weave have been used, all of the six picks of the second weave will have been used once, and in addition to these six picks, two of the picks will have been used the second time, therefore the weave would not repeat here.

427. When the 8 picks of the first weave have been used *twice*, all of the 6 picks of the second weave will have been used *twice*, and 4 of the picks will have been used the *third time*, therefore the weave does not repeat yet.

428. When the 8 picks of the first weave have been used *three times*, all of the picks of the second weave will have been used *exactly four times* and consequently the weave would repeat at this point.

429. Thus, it will be seen that the first weave will be repeated in its *picks* 3 times, making 24 picks, and the second weave will be repeated 4 times, making 24 picks, and since these two weaves are combined pick and pick, *the resulting weave will occupy 48 picks.*

430. On the other hand it will be seen that 24 *ends* will be occupied by the resulting weave in order to have the weave repeat in its ends. Therefore any weave formed by combining pick and pick an 8×8 twill with a 6×6 twill, will occupy 24 ends and 48 picks before it will commence to repeat.

431. Mention has thus far been made only of weaves formed by combining the *picks* of two twills, but another method quite frequently employed is that of combining the *ends* of two weaves.

432. All of the explanations given in relation to combining twills in their picks apply equally well when dealing with combining twills in their ends, with the exception, of course, that in the latter case the ends are being dealt with instead of the picks.

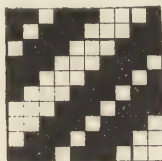


Fig. 61.



Fig. 62.

433. Figs. 61 and 62 show two twills, which it is desired to combine end and end.

434. The student will notice that these two twills occupy a different number of ends, and consequently by noting carefully the manner in which they are combined, not only the method of combining twills end and end will be understood, but also the method of determining the repeat of a weave formed by combining twills that occupy a different number of ends or picks.

435. It will be noticed that Fig. 61 occupies 10 ends, while Fig. 62 occupies only 5 ends; consequently Fig. 62 must be *repeated twice in its ends* in order to have it occupy the

same number of ends as Fig. 61. It must also be *repeated twice in its picks* in order to have it occupy the same number of picks as Fig. 61.

436. When this weave has been repeated in both ends and picks it will occupy 10 ends and 10 picks, which will give two weaves, each occupying 10 ends and 10 picks, which are to be combined end and end.

437. Consequently the resulting weave will occupy 20 *ends* and 10 *picks*. If these two weaves were combined pick and pick, then the resulting weave would occupy 10 *ends* and 20 *picks*.

438. Fig. 63 shows the weave obtained by combining Figs. 61 and 62 end and end, commencing with the *first end* of Fig. 61 and the *second end* of Fig. 62.

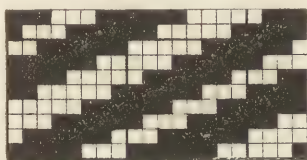


Fig. 63.

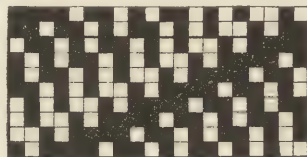


Fig. 64.

439. By noticing Fig. 63 carefully it will be seen that the

1st end of Fig. 63 is the 1st end of Fig. 61.

2nd " " " " " 2nd " " " 62.

3rd " " " " " 2nd " " " 61.

4th " " " " " 3rd " " " 62.

and so on until the weave repeats. It will be noticed that when all the ends of Fig. 62 have been used once, they are used the second time in regular order, in order to make the weave repeat.

440. Fig. 64 shows another weave formed by combining Figs. 61 and 62 end and end. In this case it will be noticed that in taking the ends, the *first* end of Fig. 61 is the first end of that weave to be taken, while the *fifth* end of Fig. 62 is the first end of that weave to be taken.

441. If the student considers that what was said in regard to producing different weaves when combining them pick and pick, applies equally well to combining weaves end and end, it will readily be understood that the number of different weaves which it is possible to produce by this method is not any less than the number that may be obtained by combining weaves in their picks.

442. Moreover, *the weaves which are combined may be re-arranged in either their ends or picks*, after the manner previously described, and then combined, so that the student will readily understand that the number of weaves which may be obtained in this manner is almost without a limit.

443. When twills are combined pick and pick they form what are termed **upright** twills. When twills are combined end and end they form what are termed **oblique** or **reclining** twills.

444. *If two regular 45° twills are combined end and end they form 27° twills.*

If they are combined pick and pick they form 63° twills.

445. *If three regular 45° twills are combined by taking a pick of each in regular order, they form a 70° twill. If they are combined by taking an end of each in regular order they form a 20° twill.*

EXAMPLES FOR PRACTICE.

446. 1. Make a regular 45° twill, twilled to the right, with the base $\frac{4}{4} \frac{3}{3}$

2. From the weave formed in answer to question 1, form another weave by re-arranging the ends in the following order, taking the first end, skipping two, taking the next, skipping two, and so on until the new weave repeats.

3. Take the two weaves given in answer to questions 1 and 2, and combine them pick and pick, taking the first pick of

the weave given for question 1, then the first pick of the weave given for question 2, and so on.

4. If a 10×10 twill is combined pick and pick with a 6×6 twill, how many ends and picks will the new weave be complete on?

5. If a 16×16 weave is combined end and end with an 8×8 weave, how many ends and picks will the new weave occupy?

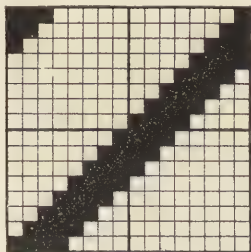


Fig. 65.

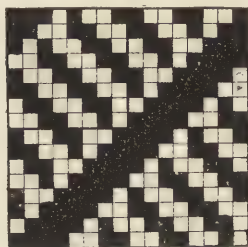


Fig. 66.

447. In addition to the regular 45° twills there are many other weaves which may be considered as sub-divisions of these regular twills and which are very useful in many classes of fabrics.

448. The first of these weaves that will be considered in this lesson are those known as “fancy twills.”

449. These weaves generally consist of one or more main lines of a regular twill weave, which run up the design, and between these main lines are placed, sometimes other twills running in the *opposite direction*, sometimes small spots and sometimes small weaves.

450. In order to illustrate this class of weaves more fully, the different steps in constructing such a weave will be given here.

451. Fig. 65 shows the first step that is always to be taken when making such weaves, and as shown is a bold line of twill running across the design.

452. In order to change the regular twill shown in Fig. 65, into a fancy twill it is necessary to *insert some other design* on the blank squares.

453. Fig. 66 shows this twill changed to a fancy twill and it will be readily understood that the method employed in this case is that of running short lines of a twill in a direction opposite to that of the main lines of twill.

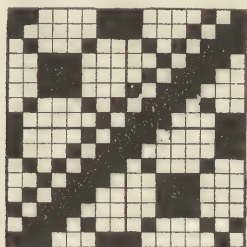


Fig. 67.

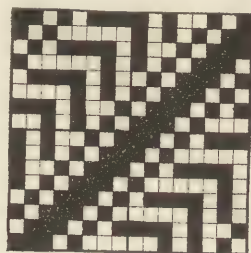


Fig. 68.

454. Figs. 67 and 68 show two other fancy twills. In Fig. 67 the twill is formed by placing *small spots* between the main lines of twill, while in Fig. 68 the twill is formed by placing a *small weave* between the main lines of twill.

455. In making these weaves the student should note carefully that the entire weave runs up in a twill line and that it is very essential to have the *first and last end*, and also the *first and last pick match*, that is the first end of the weave should be a continuation of the last end, and the first pick should be a continuation of the last pick.

456. In order to accomplish this, it is necessary to have *the spot or weave, that is inserted, occupy a number of picks which can be divided into the number of picks on which the entire design is complete.*

457. By noticing Fig. 66 the student will readily see that the small weave occupies 4 picks, which is exactly divisible into 16, the number of picks which the complete design occupies.

458. Fig. 67 is another illustration of this point. In this figure it will be noticed that *one complete spot* occupies 4 picks, which is exactly divisible into 16, the number of picks which the entire design occupies.

459. If, in any case, the spot or design which is inserted does not occupy a number of picks which can be exactly divided into the number of picks occupied by one repeat of the main twill, *then the two weaves may be made to repeat together by means of repeating each weave after the manner explained in connection with combining twills pick and pick, remembering that the picks only are repeated.*

460. Another class of weaves which may be considered as one of the sub-divisions of regular twills is that which includes those weaves known as **entwining twills**.

461. These weaves are constructed by means of running sections of twills parallel to each other in one direction, and then setting other twills across these in the opposite direction.

462. A good method to adopt when making these twills, is as follows: First, mark the *first* pick of the weave by extending the base until it occupies the number of ends on which the weave is complete.

463. For example suppose it is desired to make an entwining twill with the twill $\frac{3}{2}$ as a base, the entwining twill to be complete on 20×20 .

464. Fig. 69 will serve to illustrate the first pick of this weave. It will be seen that this pick simply consists of one pick of the weave $\frac{3}{2}$ extended for 20 ends.

465. After the first pick of the weave has been extended after the manner shown in Fig. 69 the first end should next

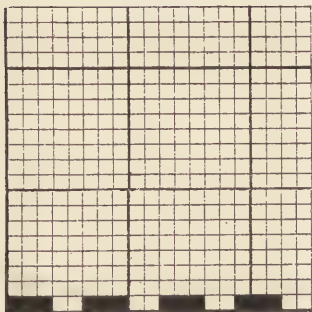


Fig. 69.

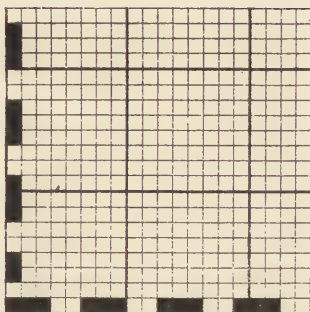


Fig. 70.

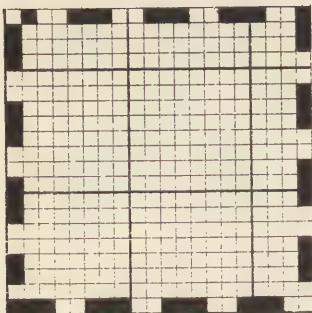


Fig. 71.

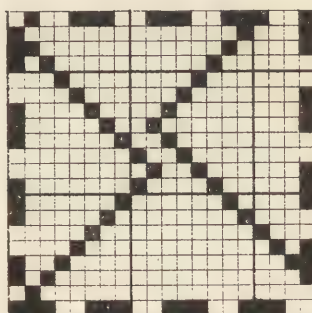


Fig. 72.



Fig. 73.

be marked. In marking the first end, *commence at the next to the top pick* and mark the end in the same manner as the first pick was marked, that is three up and two down. In this connection, however, it should be stated that the risers of the first end should not run into the risers previously marked for the first pick. Fig. 70 will serve to illustrate this point. Commencing at the next to the top pick, the first end is marked three up, two down, until the last three risers, which if marked would join with the risers of the first pick, therefore only two risers are shown.

466. The twill formed by the first pick runs from *left to right*, while that formed by the first end runs from *right to left*, therefore this will give the *last end* and the *last pick*, since the first end must be a continuation of the last end, and the first pick must be a continuation of the last pick. Fig. 71 shows the weave up to this point.

467. Next commence at the four corners of the weave and run one single line of risers in twill order from each until they meet, *running the picks from left to right and the ends from right to left*. Care should be taken not to have these different lines of risers run into each other at any point. Fig. 72 will illustrate this part of the construction.

468. The lines run in the manner shown in Fig. 72 may be considered as boundary lines, and it now simply remains to take the first and last picks, also the first and last ends and extend each line of twill until it meets one of these boundary lines, being careful not to have any of the risers run into the boundary lines. Fig. 73 shows the completed twill.

469. Another sub-division of the regular twills are those known as **curved twills**.

These are formed by taking any regular 45° twill, running it for a certain number of ends, then re-arranging the ends to form a steep twill and continuing in this order without forming any break in the design. After this has been run for a cer-

tain number of ends the twill may again be changed by re-arranging the ends a second time.

470. Fig. 74 will serve to illustrate this class of twills. It will be noticed that this weave consists of five sections, marked A, B, C, B¹ and A¹.

471. It will also be noticed that the sections A and A¹ consist of the regular 45° twill $\frac{4}{3}$, the sections B and B¹ consist of a 63° twill made by taking the ends of the twill in A and A¹ in the following order: 1, 3, 5, 7, 2, 4, 6; while the section C is composed of a 70° twill formed by taking the ends of the twill in sections A and A¹ in the following order: 1, 4, 7, 3, 6, 2, 5.

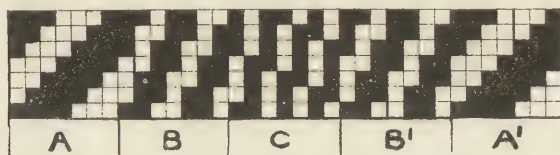


Fig. 74.

472. If the student repeats the picks of this weave two or three times on design paper the curve in the twill will show more prominently than it does in Fig. 74.

473. In the twills so far explained under the head of subdivisions of regular twills, nothing has been said in regard to the chain drafts and harness drafts, but whenever a weave is given it would be good practice for the student to make both harness and chain drafts which would be the most suitable for the weave.

474. If this is done it will be readily seen that the chain draft of the weave differs very materially from the regular twill from which the weave is derived.

475. This leads to another division of twills, namely those obtained by simply *altering the harness draft*. A little fuller explanation of this matter will not be out of place here.

476. If the student will carefully consider again the regular twill shown in Fig. 52 and the weaves derived by re-arranging the ends of this twill, it will be seen that while it would be *possible* to weave these new weaves with Fig. 52 as a chain draft, yet the harness drafts would be so broken that they would be impracticable.

477. Therefore the better method in this case would be to take *one repeat of the new weave for the chain draft and draw the ends in straight.*

478. Take for example Fig. 53 which is derived from Fig. 52. In order to weave this design in the loom, the chain draft would naturally be the same as Fig. 53 and the ends would be drawn in straight on 8 harnesses.

479. This is a good example of all the weaves previously described as being obtained from regular twills. However, there will be found a class of twills which are obtained by *using the regular twill as the chain draft and altering the harness draft to obtain the desired effect.*

480. In this connection the student should carefully study and fully understand all the explanations given in Part I., in relation to the weave, harness draft and chain draft, since an understanding of the relation which each of these bears to the others is of the first importance when considering these weaves.

481. The first weaves to be considered under this head will be those formed by skip drafts and which are known as **skip twills**.

482. These twills form a type of broken twill effects, and are made by *drawing the ends in straight for a certain number of harnesses, then missing a number of harnesses and starting again to draw the ends straight.*

483. The ends are generally drawn into the harnesses in such a maner that when the harnesses are skipped the *end in*

one harness will rise and fall exactly opposite to the next end and by this means a broken effect is formed in the cloth.

484. This will be more fully understood by considering the following figures.

Fig. 75 shows a regular $\frac{2}{2}$ twill. This twill is to be used as the chain draft and it is desired to form in the cloth a broken or skip effect.

485. Fig. 76 shows a harness draft which will give the desired effect, when using Fig. 75 as the chain draft.

Fig. 77.

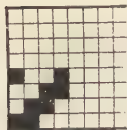


Fig. 75.

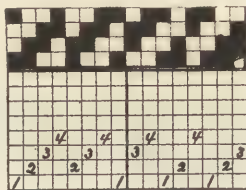


Fig. 76.

486. By studying Fig. 76 it will be seen that the first four ends are drawn *straight*, the next end instead of being drawn through the first harness, as would be the case with a straight draw, is drawn through the second harness, and the next three ends are drawn straight, this method being continued until the draft *repeats*.

487. Fig. 77 shows the effect that would be formed in the cloth with this harness draft and chain draft. In other words, Fig. 77 shows the *weave*. If the student has carefully studied Part I. there will be no difficulty in understanding the relation between these three figures.

488. The student should note carefully the effect obtained in Fig. 77 by means of skipping the harnesses in the harness draft.

It will be seen that in Fig. 77 the 5th end rises and falls exactly opposite to the 4th end. This is accomplished by

means of drawing the 5th end through the *second* harness instead of the first, as would have been done with a straight draft.

489. The 9th end rises and falls *exactly opposite* to the 8th end, and the 13th end *opposes* the 12th in the same manner. All these effects are obtained by means of the harness draft.

490. Again the student should notice carefully how the last or 16th end rises and falls *exactly opposite* to the 1st end. One end rising and falling in opposition to another in this manner is termed **cutting**, and is dealt with more fully when considering other weaves.

491. Weaves of this character are better formed by *equally flushed twills*. That is, if the weave is on 6 harnesses, the $\frac{3}{3}$ twill is the best. If on 8 harnesses, the $\frac{4}{4}$ twill is the best to use for a chain draft.

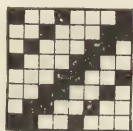


Fig. 78.

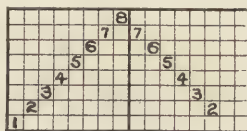


Fig. 79.

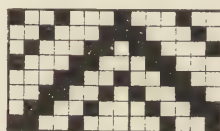


Fig. 80.

492. However, other twills may be used, and it is not necessary that an end should perfectly cut another when the harnesses are skipped.

493. Another class of twill weaves obtained by means of the harness draft includes those weaves formed by point drafts and known as **pointed twills**.

494. Centre or point drafts were fully explained in Part I. and consequently the method of making these harness drafts will need no further explanation here, simply the application of the harness draft to the chain draft and the effect formed, being dealt with.

495. Fig. 78 is a regular 45° twill, and it is desired to make a pointed or wave effect in the cloth, using this figure as the chain draft.

Fig. 79 shows a harness draft which will give a wave effect in the cloth, using Fig. 78 as the chain draft.

This is shown by Fig. 80, which gives the effect that will be obtained in the cloth by using this harness draft and chain draft.

496. One important point in connection with point drafts which was mentioned in Part I, but which will bear repetition here is the fact that *all point drafts should end on the next to the first harness and not on the first harness.*

497. Take Fig. 79 for an illustration of this point. It will be seen that the ends are drawn *straight* for the first eight harnesses, when they are *reversed* commencing with the *seventh harness*, and that when the harness draft reaches the *second harness*, after being reversed, *one repeat* of the draft is obtained.

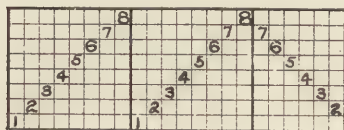


Fig. 81.

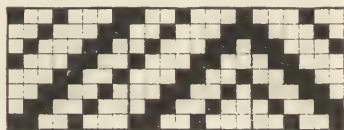


Fig. 82.

498. If the *last* end of the draft was drawn through the *first* harness, then the *first* and last ends of each repeat would work exactly alike, which would give two ends in the cloth side by side working alike. This would cause a serious defect in the fabric.

499. If the student should repeat the weave shown in Fig. 80, two or three times in both ends and picks, a better idea of the waves formed by these weaves would be obtained.

500. Many good effects can be obtained by this method of changing the harness draft and using the same chain draft. Thus instead of using a regular point draw like that shown in Fig. 79, an irregular draw like that shown in Fig. 81 could be used and the effect would be similar to that shown in Fig. 82.

501. The student will readily understand that by drawing in the ends on different irregular point drafts, many different effects may be obtained.

502. Particular notice should be taken of the fact that the *harness draft always ends with the second harness.*

503. It will be understood by the student that the point twills thus far described will make waves across, or width way of the cloth. The same effects however may be made to extend *lengthway* of the cloth by simply *reversing the chain draft* in the same manner that the harness draft was reversed when making waves across the cloth.

504. Suppose the twill shown in Fig. 83 is given and it is desired to make from this twill a chain draft which will give a wave running length way of the cloth.

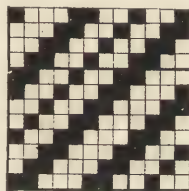


Fig. 83.

505. It is then simply necessary to make a chain draft which will have the first 12 picks similar to Fig. 83 and the remaining picks made by *reversing these first 12 picks*, that is:

the 13th pick will be like the 11th

" 14th " " " " " 10th

" 15th " " " " " 9th

" 16th " " " " " 8th

" 17th " " " " " 7th

" 18th " " " " " 6th

" 19th " " " " " 5th

" 20th " " " " " 4th

" 21st " " " " " 3d

" 22d " " " " " 2d

506. Here the chain draft will stop, in order to *avoid having the first and last picks alike*, on the same principle that the harness drafts of all weaves making waves across the cloth always stop on the next to the first harness.

507. Fig. 84 shows the chain draft to give the wave lengthways of the cloth. The harness draft would be a 12 harness straight draw.

508. Explanations have now been given showing how waves across the cloth and also lengthway of the cloth may be formed from regular twills by simply reversing the drawing in draft for the former and the chain draft for the latter.

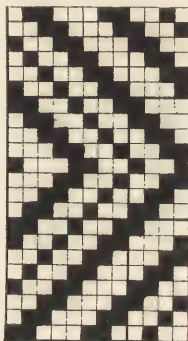


Fig. 84.

509. By going one step further, that is by reversing *both* the harness and chain drafts of any regular twill, another class of weaves which is very largely used, will be formed.

Weaves formed in this manner are known as **diamond weaves** on account of the effects which they form in the cloth.

510. One illustration of these weaves will be given here, from which the student should readily understand their construction. Fig. 85 shows a regular twill from which it is desired to construct a diamond weave.

511. First build the chain draft by reversing the picks in exactly the same manner as described when explaining the formation of waves lengthway of the cloth.

For the purpose of illustration, however, the picks will be reversed from the *first* pick instead of from the last, as was the case in the previous illustration. It should be understood that with either case the weave will be the same.

Fig. 86 shows Fig. 85 reversed in this manner.

512. Fig. 86 should be considered as the chain draft of the desired weave, while as previously stated, the drawing-in draft is to be a regular point draft made on the same principle as were the chain drafts for the regular weaves which were made into waves extending across the cloth.

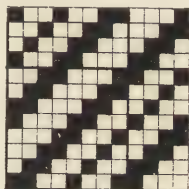


Fig. 85.

513. It will be seen that the chain draft occupies twelve harnesses, and consequently the drawing-in draft will be the twelve harness regular point draft.

In other words, the ends will be drawn in 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2.

514. The student should notice that in this case, as well as in weaves forming wave effects, the last pick matches up perfectly with the first, also the last end with the first.

515. In order to show the effect that will be formed in the cloth when using Fig. 86 for the chain draft and the warp ends drawn in in the manner indicated in Clause 513, the weave has been worked out and is shown in Fig. 87.

516. The manner of showing the effect in the cloth when the chain draft and drawing-in draft are known, has previously been described and the student will readily understand the method of obtaining Fig. 87.

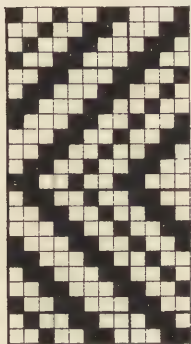


Fig. 86.

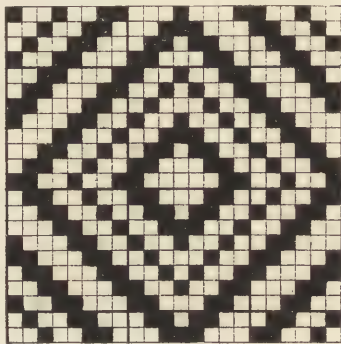


Fig. 87.

MISCELLANEOUS WEAVES.

517. As was explained in Part III. of Designing, there are certain fundamental weaves from which all other weaves are derived. Twills were spoken of as being a class of these weaves, and the method of deriving other weaves from these has been fully explained. Another class of weaves which may be considered as belonging to this group is that which includes those weaves known as **satins**, or **sateens**. These will be dealt with in the first part of this lesson.

518. It will be remembered that a regular twill weave is one which forms a regular twill line across the cloth, either from right to left, or from left to right, and that in order to do this it is necessary to have one end of the weave support the end next to it, that is, if on one pick a certain end is raised and the one next to it in the direction of the twill is lowered, then that end which was lowered must be raised on the next pick, although it is not necessary to have the end, which was previously raised, lowered on this pick.

519. A satin weave is the exact opposite of a twill, since, while it is the object of a twill weave to show a twill line running across the cloth, it is the object of the satin weave to avoid any twill line as far as possible, although in some cases a twill is shown in a satin weave by means of the direction of the twist in the warp and filling yarns.

520. It will be seen that since the foundation of a twill weave is the supporting of one end by another, and since the satin is the direct opposite of the twill, then the foundation of the satin weave must be the *non-supporting of any one end by another*, and this is the principle on which all regular satin weaves are constructed, that is, *the interlacing of each end is at*

least one pick apart from the interlacing of either of the ends next to it, moreover in a regular satin weave, each end in one repeat of the drawing-in draft, interlaces with the filling only once in one repeat of the weave.

521. Figs. 88 and 89 will serve to make these few points somewhat clearer to the student.

As will be seen, Fig. 88 shows a regular 5 end twill, 4 up, 1 down, but while only one end is changed on each pick, yet the ends support each other, since on the first pick the first end is lowered, and on each succeeding pick the next following end is lowered, thus forming a twill line.



Fig. 88.



Fig. 89.

522. By referring now to Fig. 89, which shows a regular 5 end satin weave, it will be seen that while these two weaves are alike in that only one end is changed on each pick, yet Fig. 89 differs from Fig. 88 in having the interlacing of each end at least one pick apart from the interlacing of either of the two ends next to it.

523. By referring to Fig. 89, the student will see that on the first pick the first end is lowered, on the next pick the fourth end is lowered, on the third pick the second end is lowered, on the fourth pick the fifth end is lowered, and on the fifth pick the third end is lowered.

Thus it will be seen that in a regular satin weave, such as is shown at Fig. 89, the points of interlacings do not run up in regular order, as is the case in a regular twill weave, but instead are scattered over the weave. By this means the interlacings of the warp and filling are almost entirely hidden, and the cloth produced by such a weave is the softest of any to the feeling, which, in fact, may be considered to be the object of the satin weave.

524. From the description already given of satin weaves, the object of these weaves can be readily determined. The method, however, of making a satin weave on design paper should be carefully considered, as there are definite rules for forming every satin.

525. In any regular satin, each harness is only raised or lowered once in each repeat of the weave, and in speaking of the order in which the harnesses are moved, it is generally shown by means of numbers which designate the number of the harness, and also show on which pick the harness is to be moved. Thus, referring to the 5 end satin in Fig. 89, it would be said that the harnesses are moved in 1-4-2-5-3 order.

526. When speaking of the harnesses being moved in this order, the figures represent the harnesses, and the order in which the figures stand shows the pick on which that harness is moved. Thus, in this case, 1 being the first number shows that the first harness, or number 1, is moved on the first pick, 4 being the second number shows that number 4 harness is moved on the second pick; 2 being the third number shows that number 2 harness is moved on the third pick; 5 being the fourth number shows that number 5 harness is moved on the fourth pick; and 3 being the 5th number shows that number 3 harness is moved on the fifth pick.

527. By carefully considering the order of lowering the harnesses in Fig. 89, it will be seen that one harness is moved on one pick, and on each successive pick the 3d harness (counting from front to back) from the one previously moved is changed. Thus on the first pick it will be seen that the first harness is moved, on the second pick the third harness from that, or the fourth, is moved. On the next pick the third harness from the fourth, or the second, is moved, and so on for the five picks, which complete one repeat of the weave.

528. This is known as *moving in threes*, and it will be seen that 3 is a number which cannot be equally divided into 5, the

number of picks to the repeat, neither can any number which is divisible into 5 be equally divided into 3. This is the basis on which the satin weaves are constructed. That is, a number is taken for a base *which cannot be divided equally into the whole number of ends in one repeat, and which cannot be equally divided by any numbers divisible into the total number of ends in one repeat.*

Thus it will be seen that 2 could be taken for a base for a 5 end satin, as well as 3, when the harness would be moved in the following order, 1-3-5-2-4. It will be seen that if the harnesses are moved in this order, and the ends drawn in straight, no two successive ends will be supporting each other, and consequently the satin will be regular.

529. It should be stated here that 5 harnesses is the smallest number on which a regular satin can be constructed. Also that a regular satin cannot be constructed on 6 harnesses, although in many cases a weave known as an irregular satin is made on 6 harnesses, the order of lifting the harnesses being as follows: 1-3-5-2-6-4, or 1-4-2-6-3-5.

530. It will be seen that in weaves in which the harnesses are raised in either of these orders, no two adjacent ends will be raised on successive picks, or in other words, no two ends will support each other, and yet the same number of ends are not skipped between each pick. Take, for example, the first order of raising the harnesses, and it will be seen that on the first pick the first harness is raised, on the second pick the second harness from the one previously moved, counting from front to back, or the 3d, is raised; on the 3d pick the second harness from the previous one, or the 5th, is raised; but on the next pick the third harness from the 5th, or the 2d, is raised; and on the next pick the fourth harness from the 2d, or the 6th, is raised; while on the last the fourth harness from the 6th, or the 4th, is raised. Thus it will be seen that in some cases the order in which the harnesses are taken, moves in twos, while in others it moves in threes, and sometimes in fours, consequently the weave is not regular.

531. Referring again to what has previously been said in regard to the method of obtaining the base for any satin weave, it will be supposed that it is desired to make a satin on 7 harnesses. It may be said here that in any case where it is desired to construct a satin weave on an odd number of harnesses, the base taken can always be 2, since 2 cannot be divided equally into an odd number, neither can it be divided by any number which can be divided equally into an odd number. Thus in the case of a 7 harness satin, the harnesses could be moved in the following order: 1-3-5-7-2-4-6.

532. If the student places this on design paper, it will be readily seen that the order of moving the harnesses is regular, and at the same time no two ends support each other, consequently the satin will be regular. Still another order of moving the harnesses would be by threes, in which case the following would result: 1-4-7-3-6-2-5. That is, as previously explained, on the first pick the first harness would be moved, on the 2d pick the 4th harness would be moved, on the 3d pick the 7th harness would be moved, on the 4th pick the 3d harness, on the 5th pick the 6th harness, on the 6th pick the 2d harness, and on the 7th pick the 5th harness.

533. Still another base that could be taken for a 7 end satin would be 5, in which case the harnesses would be moved in the following order: 1-6-4-2-7-5-3. It will also be seen that with a 7 harness satin the harnesses could be moved on a basis of four, in which case they would be moved as follows: 1-5-2-6-3-7-4.

In all of these cases it will be seen that no two ends support each other in the weave, and also that the harnesses are moved in regular order, that is, a definite number of picks apart.

534. That the student may fully understand the construction of satin weaves, another example will be given here. Suppose for instance, it is desired to construct a satin weave on 9 harnesses. Proceeding as stated before, it is first necessary to obtain a number smaller than 9 which is not equally divisible

into the number of harnesses and neither can it be divided equally by any number which can be divided into 9. Thus, for instance, it will be seen that 5 would be such a number, and 5 consequently could be taken as a basis for moving the harnesses, which would give the following: 1-6-2-7-3-8-4-9-5.

535. With this order it will be seen that on the first pick the 1st harness is moved, on the second pick the 6th harness is moved, on the third pick the 2d, on the fourth pick the 7th, and so on until all the harnesses are moved once which gives one repeat of the weave.

536. There is one point which should be noted carefully by the student, which is, that there are two classes of satin weaves, known as **filling satins** and **warp satins**.



Fig. 90.

537. The filling satin may be defined as one in which there is more filling on the face of the cloth than there is warp. By looking at a satin design on design paper it will be possible to readily distinguish a warp from a filling satin. Thus, for instance, if more of the squares on design paper are filled out than are left blank, it will be readily seen that the warp will predominate, since filled squares represent the warp ends lifted and in this case the satin would be a warp satin.

In case more of the squares were left blank than were filled out it would be readily seen that the satin would be a filling satin, since the blanks represent filling over warp.

538. When a satin is a warp satin the harnesses are said to be *lowered* in a certain order, while with a filling satin the harnesses are said to be *raised* in a certain order. Thus, for example, by referring to Fig. 89, it will be seen that the satin shown in this illustration is a warp satin, since it will be seen

that with this weave the warp will predominate, and in speaking of the order in which the harnesses would be moved it would be said that they are *lowered* in 1-4-2-5-3 order, while in Fig. 90, which shows a filling satin, the harnesses would be said to be *lifted* in 1-4-2-5-3 order.

539. In case of a filling satin it is the general custom to place more picks per inch in the cloth than ends, and by this means the ends which are raised over the picks are nearly covered, thus causing the cloth to have a very soft feeling. On the other hand in the case of a warp satin, there are generally more warp ends per inch than picks, thus causing the warp ends to crowd over the picks which are raised, and producing the same effect as in the filling satin.

540. What has previously been said in regard to the method of constructing a satin weave and placing the same upon design paper may be summarized in the following remark:

1st. In order to construct a regular satin it is necessary to determine upon a number which may be used as a base.

2d. In order to obtain a number which is to be used as a base, divide the number of harnesses on which the satin is to be made into two unequal parts, these parts to be such that one cannot be divided equally by the other and they shall not be divisible by a common number.

A satin is one which is constructed in the regular order by the above rule.

541. It should be remembered that a 6 end satin cannot be constructed by either of the above rules and is not a perfect one. It is, however, often made as follows: 1-3-5-2-6-4, or 1-4-2-6-3-5, and is extremely useful, its irregular appearance being an advantage for some purposes.

542. In order to enable the student to thoroughly understand the construction of satin weaves a few illustrations will be given here and each one thoroughly explained.

Fig. 91 shows a 7 end filling satin. By referring to this figure the student will see that on the first pick the first end is raised, and on the second pick two ends are missed and the fourth end raised; on the next pick two ends again are missed and the seventh end raised. This method of skipping is continued for seven picks, which is one repeat of the weave.

543. It will be seen that the order of raising the harnesses is regular throughout and that also no end is supporting another. Consequently the weave is a regular satin. This weave would be said to be constructed on a base of three, since every third end is taken.

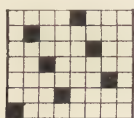


Fig. 91.

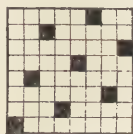


Fig. 92.

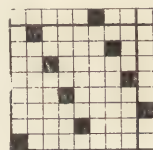


Fig. 93.

544. It will be noticed that when counting to find which end will be raised when the last end, or as in this case the seventh is reached, the next end in order will be the first. Thus, for instance, on the fifth pick of this weave the sixth end is raised. Counting from this end in order to see which end will be raised on the next pick it will be seen that after counting one it will be necessary to go to the first end again, which will be considered two, and the third end from the sixth will be the second end of the weave, which will be the end which will be raised on this pick. This is due to one repeat of the weave occupying only seven ends and consequently the eighth end of the weave will be similar to the first, the ninth similar to the second and so on, as has been explained in previous lessons.

545. Fig. 92 shows an eight end filling satin constructed on a base of three, that is, one end is raised on one pick and on the next pick the third end from the one previously raised is raised.

By carefully studying this weave the student will readily understand the principle of its construction.

546. Fig. 93 shows a nine end filling satin weave. In this case the satin is constructed on a base of four. Thus, by referring to this figure it will be seen that on the first pick the first end is raised; on the second pick the fourth end from this one or the fifth end is raised, on the third pick the fourth end from the fifth or the ninth end is raised; on the fourth pick the fourth end from the ninth, or the fourth end is raised. This is continued for the nine picks which completes the repeat.

547. Fig. 94 shows a ten end filling satin with a base of three.

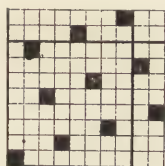


Fig. 94.

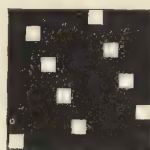


Fig. 95.

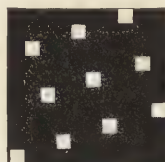


Fig. 96.

Fig. 95 shows a nine end warp satin weave constructed on a base of four. It will be seen that in the case of warp satins all the ends are up on each pick with the exception of one. Thus in the case of Fig. 95 on the first pick all the ends are raised with the exception of the first end which is lowered, and on the second pick, the fourth end from this first end or the fifth end is lowered, and on the third pick three ends are skipped and the ninth end is lowered, on the fourth pick three ends are skipped and the fourth end is lowered. This is continued for the nine picks which complete one repeat of the weave.

548. Fig. 96 shows a ten end satin weave constructed on the base of three. It will be seen that in this case as in the case of Fig. 95 all the ends with the exception of one are raised on each pick and also that each end is lowered only once in one repeat of the weave.

549. In all of these examples of satin weaves the student will notice that the base which is taken is a number which cannot be divided equally into the number of ends in one repeat of the weave and also it is not divisible by any number which can be divided into the number of ends in one repeat. Thus, to take one example from these illustrations, by referring to Fig. 93 it will be seen that the weave is a nine end satin, moving in fours. Four is a number which is not divisible into nine, neither can it be divided by any number which can be divided into nine without a remainder.

550. In speaking of the order of lifting the harnesses in any filling satin weave it would be given in the order that the ends are raised on each pick. Thus, for instance, in Fig. 92, the harnesses are raised in 1-4-7-2-5-8-3-6 order. As previously explained this would show that on the first pick the first end is raised, on the second pick the fourth end is raised, on the third pick the seventh end is raised, on the fourth pick the second end is raised, on the fifth pick the fifth end is raised, on the sixth pick the eighth end is raised, on the seventh pick the third end is raised, on the eighth pick the sixth end is raised.

551. Generally, in making a chain draft for a satin weave it is made similar to the weave. That is, in most cases the weave will be found to be the chain draft, and when this is the case the ends of course will be drawn in straight, that is, through the harnesses in consecutive order. This is true in all the cases of examples given here, the weave in each case being the chain draft and the harness draft being a straight draft on whatever number of harnesses the weave is complete on.

552. There is a second class of satin weaves which are made from regular satins and are known as **double satins**. These weaves are constructed from a satin base by *adding one mark to each mark in a single satin*. That is, in case the satin is a filling satin, then each end will be raised an extra time during one repeat of the weave. In case the satin is a warp

satin each end will be lowered an extra time during one repeat of the weave. These marks may be placed above or at the side of the satin mark, but it is better to place them in such a position that the ends will not be supported by the ends next to them in the weave.

553. Fig. 97 shows a double satin. The crosses show a regular satin or the satin base from which the double satin is made. Considering first the crosses alone and ignoring the filled-in squares, it will be seen that the crosses represent a regular 8 end satin weave constructed on a base of three, giving the order of lifting the harnesses as follows: 1-4-7-2-5-8-3-6. In order to convert this regular satin weave into a double satin one riser is placed on each pick in addition to the riser of the regular satin weave. Thus it will be seen that on the first pick, in addition to the first end being raised, the seventh end is also raised.

554. In this case five ends are skipped and the sixth end marked; that is, in a regular satin weave, on the first pick the first end is raised, five ends are then skipped and the seventh end raised. In all double satin weaves the extra risers must be placed in regular order; that is, if on the first pick of the weave the extra riser is placed in a certain position in relation to the riser of the regular satin weave then on the second pick the extra riser must be placed in the same relative position. This it will be seen has been done in this weave. Thus it will be seen that on the second pick of this weave the fourth end is raised, then five ends are skipped and the second end raised. This will be seen to correspond with the method of marking the extra riser on the first pick of the weave, and this is continued throughout the eight picks which complete one repeat of the weave.

555. Fig. 98 is another illustration of a double satin weave. It will be seen by referring to this figure that the extra risers are placed at the right of the risers of the satin

weave. In this figure, as in the case of Fig. 97, the crosses represent the regular satin weave while the filled in squares represent the extra risers that are placed on each pick in order to make the satin a double satin. Thus, on the first pick of this weave it will be seen that the first end is raised in the regular satin weave. In order to make a double satin, the square to the right of the one containing the crosses of the satin weave is marked, or in other words, the second end is raised together with the first. On each pick the square to the right of the one marked with the cross is filled in and thus the regular satin is made double.

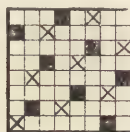


Fig. 97.



Fig. 98.

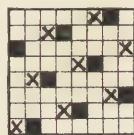


Fig. 99.

556. It will be noticed by referring to the fourth pick of this weave that in order to mark the square at the right of the one marked for the regular satin weave, it will be necessary to show an extra end or the sixth end, but since the weave is complete on five ends and five picks, the first end of the weave is marked, which is the same as the sixth end of the weave. This point has been thoroughly dealt with before and consequently needs no further explanation here.

557. Fig. 99 shows an 8 end double satin. By considering the crosses which show the order of lifting the harnesses for a regular satin weave and also the filled in squares which are added, the student will readily understand the method of constructing this weave.

558. Satin weaves furnish a ready means of constructing other weaves, or in other words, derivatives, but in most every case satin derivatives are formed by adding one or more extra risers to the risers in the regular satin.

559. In order to illustrate a few forms of satin derivatives, examples will be given here and explained. Fig. 100 shows a satin derivative which might be considered as a double satin and yet would form a fine upright twill in the weave. In these examples the crosses show the method of raising the harnesses for a regular satin, while the filled in squares show the method of adding risers in order to form derivatives. Thus, in Fig. 99, it will be seen that the crosses show the order of lifting the harnesses for a regular 8 end filling satin weave and to each one of these is added a filled in square.

Fig. 101 shows a satin derivative formed by adding two filled in squares to each riser in a regular 8 end filling satin weave.

Fig. 102 shows a satin derivative formed by adding three risers to each riser in a regular 8 end satin.

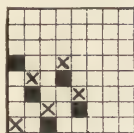


Fig. 100.

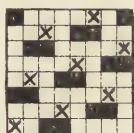


Fig. 101.



Fig. 102.

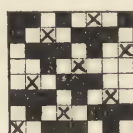


Fig. 103.

Fig. 103 shows a satin derivative formed by adding four risers to each riser of a regular 8 end satin weave.

560. In all of these cases the student should carefully notice that whenever it is necessary to extend the risers beyond the last end of the weave they are carried to the first end, and in case it is necessary to extend the risers beyond the bottom pick of the weave, they are carried to the top pick, or vice versa.

561. Fig. 104 shows a satin derivative formed by adding three risers to each riser of a regular 12 end filling satin. This weave is known as a twill basket weave. The different basket weaves and the method of forming them will be explained later in this lesson.

Fig. 105 shows a satin derivative formed by adding six risers to each riser of a regular 16 end filling satin.

By considering these different derivatives and the method of forming them, the student will be able to work out many others on design paper.

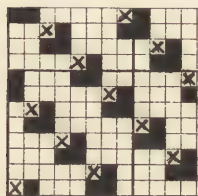


Fig. 104.

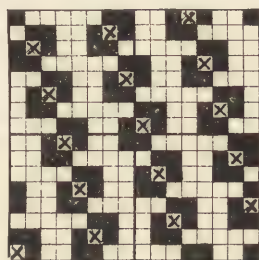


Fig. 105.

EXAMPLES FOR PRACTICE.

562. 1. Make a warp satin on sixteen harnesses, moving in fives.

2. Make a filling satin on sixteen harnesses, moving in sevens.

3. From the weave formed in answer to question 2, construct a double satin, by adding one riser to each riser of the satin weave.

4. What is the smallest number of harnesses on which a regular satin weave can be constructed? Show a satin weave on this number of harnesses.

5. Are forms of satin weaves ever constructed on a less number of harnesses than you give in answer to question 4? If so construct one.

563. **Granite weaves** are not always constructed on a satin base, but this will be found to be the readiest method of producing one of these weaves. Granite weaves form small broken effects and produce an indistinct, yet regular pattern which will be found to be used extensively in all classes of woven fabrics.

564. In connection with granite weaves, what has previously been stated in Part III. in regard to re-arranging regular twills in ends and picks should be carefully noted. Granite weaves may be obtained by making a small regular twill weave and then re-arranging this twill in what is known as satin order, that is, taking the ends of the twill in such an order as is followed when making a satin weave.

565. If, for example, a twill is made on eight ends, in order to form a granite weave, these ends should be arranged in a satin order. If taken by threes, the ends would be arranged as follows: 1-4-7-2-5-8-3-6, that is, the first end of the new weave would be similar to the first end of the twill, the second end would be similar to the fourth end of the twill, the third

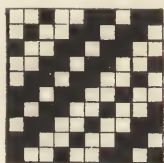


Fig. 106.

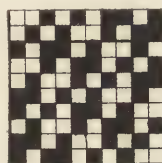


Fig. 107.

end similar to the seventh, the fourth end similar to the second, the fifth end similar to the fifth, the sixth end similar to the eighth, the seventh end similar to the third, and the eighth end similar to the sixth.

566. By referring to the re-arrangement of the ends and picks of regular twills as explained in Part III., the student will see that this is similar, and in fact the weave shown previously in Fig. 54, Part III., is a good example of granite weaves.

567. In producing a granite weave the principle object to be obtained is a broken effect in the weave. To illustrate the manner of obtaining a granite weave from a regular twill, one example will be given here.

568. Fig. 106 shows a regular twill weave constructed with a base of 1 up, 2 down, 1 up, 2 down, 2 up, 1 down, 1 up.

Suppose the first two ends of this weave are taken, four skipped, two taken, four skipped, and so on, until the weave repeats, then the granite weave, as shown in Fig. 107, will result. The student should remember that the object of these weaves is to show as broken an effect as possible.

569. Another class of weaves which is very largely made from a satin base is that known as **basket weaves**. Although these weaves are not in all cases formed from a satin base, a description of each kind of basket weave will be given here. There are four types of these weaves and they are made on from four to sixteen harnesses, the chief feature of these being the regular occurrence of large floats of both warp and filling. These weaves will be met with frequently in all classes of woven fabrics.

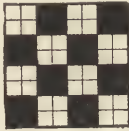


Fig. 108.

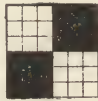


Fig. 109.

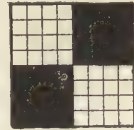


Fig. 110.

570. The first type of basket weaves consists of those in which the squares of warp and filling are of equal size. These baskets are simply extensions of the plain weave, both warp way and filling way, and it is always possible to weave them on two harnesses.

571. Fig. 108 shows an ordinary basket weave. It will be seen by studying this weave that each square which is marked in a regular plain weave is simply extended for two ends and two picks, thus making each mark occupy four squares instead of one.

572. Fig. 109 shows another basket weave of this class in which each mark of the plain weave is extended for three ends and picks, and thus it will be seen that instead of occupying only one square, each mark occupies nine.

Fig. 110 is still another illustration of this type. In this case each mark being extended for four ends and four picks, and consequently occupies sixteen squares instead of one.

573. A second type of these weaves consists of **twill baskets**, which are generally constructed on a satin base and make much neater effects than basket weaves of the first kind.

In making a twilled basket from a satin base, first mark out a satin weave on the desired number of ends and picks. Around the squares marked off for the satin base, fill in squares in such a manner that the filled in squares will form squares, and also will run up in regular twill order.

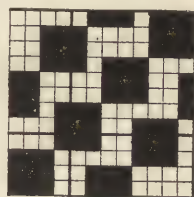
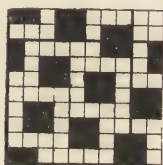
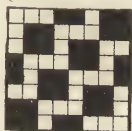


Fig. 111. Fig. 112. Fig. 113. Fig. 114.

574. Fig. 111 shows a twilled basket constructed in this manner. By referring to this figure it will be seen that the basket weave is formed from an 8 end satin weave with a base of five. The crosses show the satin weave, and the student will readily see the method of first marking the satin weave on the desired number of ends and picks. In this case, after the satin weave has been constructed, the basket weave is obtained by *filling in three squares around each cross of the satin weave*. By this means the weave runs up in regular twill order.

575. In making these weaves, care should always be taken to have the filled in squares around each mark of the satin base correspond in every particular. That is, if on the first mark of the satin weave one square to the right and two below are filled in, as is the case in Fig. 111, then on every other mark of the satin weave the corresponding squares must be filled in.

576. Fig. 112 shows another illustration of this twill basket.

It will be seen that the weave in Fig. 112 is the same as the weave in Fig. 111, the difference in their appearance being due to the fact that the extra filled in squares are placed in different relative positions.

577. Fig. 113 shows another twill basket weave. In this case the basket weave is constructed from a ten end satin, with a base of seven.

Fig. 114 shows a twill basket weave which is not constructed directly from a satin base, but which runs up in regular twill order.



Fig. 115.

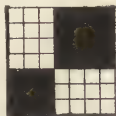


Fig. 116.

578. In case of the examples shown in Figs. 112 and 113, the marks for the satin weave are not shown any differently from those which form the basket weave, but by carefully considering the different weaves, the student will be able to understand the method of marking them. In each of these cases the filled in square at the lower left hand corner is the first mark of the satin weave.

579. The third type of this class of weaves consists of those known as **irregular baskets**. In this case the squares of warp and filling are not exactly equal.

Fig. 115 shows a type of this class of basket weaves. In this case it will be seen that the filled in squares in one portion of the weave occupy three ends and three picks, while in another portion they occupy but two ends and two picks.

580. Fig. 116 is another illustration of this same type of basket and is formed by extending the floats in one case for three ends and three picks, and in another for four ends and four picks.

Fig. 117 shows a weave which is known as a **fancy basket** weave. It will be seen that in this case the squares of filling are broken in the centre by means of a float of warp, while the squares of warp are broken by a float of filling. In this case a more compactly woven cloth is obtained than with the basket of the ordinary type.

Fig. 118 shows still another weave constructed after this same manner. In weaving either of the designs shown in Fig. 117 or 118, it would be necessary to employ two warps in order to weave an even cloth.



Fig. 117.

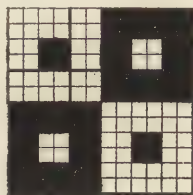


Fig. 118.

581. Rib Weaves are simply extensions of the plain weave, but while as previously explained, the mat or basket weave is an extension of plain weaves on both picks and ends, it will be found that rib weaves are extensions of plain weaves in either the ends or picks alone. Thus, a **warp rib** weave will be found to be an extension of a plain weave in picks.

582. Fig. 119 is an illustration of a warp rib weave, and by carefully considering its construction this class of weaves will be readily understood by the student. It will be noticed that this figure is divided into two sections, A and B. In section A all the odd numbered ends float over the filling for 4 picks, while the even numbered ends are down for these 4 picks, while in section B the reverse is the case; that is, the even numbered ends float over the filling, while the odd numbered ends are under the filling.

583. With this class of weaves a distinct line is formed *across* the cloth by means of the ends covering the filling. Thus by considering Fig. 119 in the section marked A, for the 4 picks that the odd numbered ends are over the filling, these ends will have a tendency to crowd together, especially if there are more ends than picks per inch in the weave, as there should always be in a warp rib weave. That is, the first and third ends will cover the 4 picks of filling which are raised over the second end; the third and fifth ends for these 4 picks will cover the filling which is raised over the fourth end; the fifth and seventh ends will cover the filling that is raised over the sixth end, and the seventh and first ends will cover the filling which is raised over the eighth end.

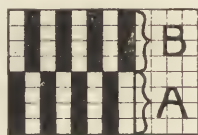


Fig. 119.

584. For the next four picks the reverse will be found to be the case. That is, the second and fourth ends will cover the filling which is raised over the third end; the fourth and sixth ends will cover the filling which is raised over the fifth end and so on. Consequently in these eight picks two distinct lines will be formed across the cloth by means of different ends covering the filling in these two sections. It will be seen that the weave repeats on two ends and eight picks. Four repeats of the weave in the ends are shown here in order that the student may understand the weaves more clearly.

585. **Filling rib** weaves are the exact opposite of warp rib weaves. In this case the filling will be found to cover the ends, and consequently the ribs will be formed lengthways of the cloth, and for this reason the cloth should always contain more picks per inch than ends. Fig. 120 is an illustration of this class of weave.

586. In this case it will be found that in the section marked B all the odd numbered picks float over these 4 ends, while all the even numbered picks are under the ends. In this case the first and third picks will crowd over the ends which are up on the second pick and completely cover them; the third and fifth picks will cover the ends which are raised on the fourth pick, and the fifth and seventh picks will cover the ends which are raised on the sixth pick, and the seventh and first picks will cover the ends which are raised on the eighth pick, thus showing a distinct line of filling lengthways of the cloth.

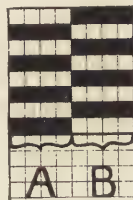


Fig. 120.

587. In the section marked A it will be seen that the exact reverse is the case. That is, all the even numbered picks are raised over the ends, while the ends are raised on the odd numbered picks. By this means the second and fourth picks will cover the ends which are raised on the third pick; the fourth and sixth picks will cover the ends which are raised on the fifth pick, and so on, thus forming another rib lengthways of the cloth. It will be seen that this weave is complete on 2 picks and 8 ends, 4 repeats of the weave in its picks being shown here.

588. It should be thoroughly understood by the student that in Fig. 119 the section marked A will form a distinct rib *across the cloth*, while the section marked B will form another distinct rib *across the cloth*, these ribs in both cases being formed by means of the warp ends covering the filling.

589. In Fig. 120 the section marked A will form a distinct rib *lengthways of the cloth*, while the section marked B will form another distinct rib *lengthways of the cloth*, the ribs in this weave being formed by means of the filling covering the warp ends.

It will be noticed that in the illustrations given of rib weaves the ribs are of equal size. It is not necessary to have the ribs of an equal size in all cases, since many times unequal ribs will be formed in the cloth.

590. Fig. 121 is an illustration of a weave of this kind. It will be noticed by referring to this figure that in the lower section the odd numbered ends float for five picks, while in

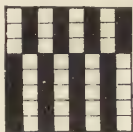


Fig. 121.

the upper section the even numbered ends float for only three picks. In this case there would be two ribs across the cloth of unequal size, one rib being the width of five picks, while the other would be the width of three picks. Unequal filling rib weaves could be formed in the same manner, that is, by having the filling float over an unequal number of ends.

591. **Corkscrew weaves** may be considered as a class of rib weaves, but while in the rib weaves previously explained, the ribs extended in a straight line either across the cloth or lengthwise of the cloth, in corkscrew weaves these ribs would be found to *form a twill line*, and for this reason are sometimes known as **corkscrew twills**. Again corkscrew weaves are frequently derived from twills by re-arranging either the ends or picks of a regular 45° twill. These weaves may be formed on any number of ends or picks above five, but in order to have the different ribs equal, it is necessary to have the weaves

complete on an uneven number of picks. This class of corkscrew weaves will be considered first.

592. One method of making a corkscrew weave and one which will be found to be as simple as any, may be explained as follows: Suppose that it is desired to form a corkscrew weave which will be complete on 7 picks. Divide 7 into two numbers, one of which shall be larger than the other by 1. In this case it will be seen that 4 and 3 will be such numbers. Then take 4 up, and 3 down, as the basis to mark each *end* in the corkscrew weave.

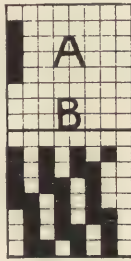


Fig. 122.

593. At A, Fig. 122, the first end of the corkscrew weave on 7 picks is shown, that is, this end will be seen to be raised for 4 picks and lowered for 3 picks. For the second end of the weave, *commence on the first pick on which the first end is raised*, and mark the second end 4 up and 3 down, *counting down*. For the third end of the weave commence on the last pick on which the second end was marked, and mark 4 up and 3 down, counting down. Continue in this manner until the weave is complete. It may be stated here that corkscrew weaves which are complete on an odd number of picks will always be complete on the same number of ends as picks. Thus, in this case, since this weave is complete on 7 picks, it will also be complete on 7 ends. The complete weave is shown at B, Fig. 122.

594. It will be seen that if the eighth end was marked in a manner similar to that described, it would be similar to the first end of the weave; the ninth end would be similar to the second end of the weave, and so on, thus showing that the weave repeats on 7 ends.

595. As previously stated, all corkscrew weaves which are complete on an odd number of picks will have their ribs equal. Thus, in the case of the example shown here, each rib running in a twill line across the cloth is of equal size. This weave would be known as a **warp corkscrew**, since in this case the same is true as in the case of warp ribs, that is, the warp ends will cover the filling and consequently nothing but warp will show either on the face or the back of the cloth. In order to have these weaves show up to the best advantage, it is necessary, as was the case with warp rib weaves, to have more ends than picks per inch.

596. In the second class of these weaves, that is, where the ribs are of unequal size, the weave will not be found to repeat until it has been carried out for *twice the number of ends as picks*.

In constructing these weaves it will be found necessary to divide the number which represents the number of picks on which the weave is complete, into two numbers, one of which shall be larger than the other by 2.

597. Suppose, for an example, that it is desired to construct a corkscrew weave which shall be complete on eight picks. Then divide this number as explained before. The two numbers will be found to be 5 and 3. Mark the first end of the weave 5 up and 3 down. The first end of a corkscrew weave which will be complete on eight picks is shown at A, Fig. 123.

598. For the second end of the weave, commence on the first pick on which the first end is raised, and raise the second end on this pick and also on all the picks on which the first end is lowered. By doing this it will be seen that the second end will be up 4 picks and down 4 picks, whereas the first end

is up 5 picks and down 3. Marking the third end in the same manner as is employed when marking the second, it will be seen that this end will be up for 5 picks and down 3, thus being similar to the first end as regards the length of the floats.

599. The complete weave is shown at B, Fig. 123, and by carefully considering this figure it will be seen that all the odd numbered ends are up for 5 picks and down 3, while the even numbered ends are up 4 and down 4. Therefore since the ribs are formed by ends which are raised, crowding over

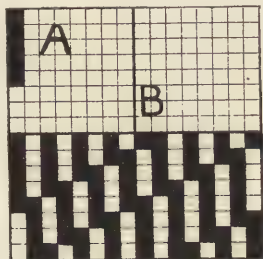


Fig. 123.

the filling, it will be readily seen that 2 ribs will be formed across the cloth, one of which is the width of 5 picks, while the other is the width of only 4. Again, it should be noted that in this case it is necessary to carry the weave out for twice the number of ends as picks before it commences to repeat.

600. As previously stated, corkscrew weaves are often known as corkscrew twills, and are readily formed from twills, first, by re-arranging the ends or picks of a regular 45 degree twill, or second, by combining two twills end and end or pick and pick.

601. First considering the formation of corkscrew weaves by re-arranging the ends of a regular 45 degree twill, for illustration, suppose it is desired to re-arrange the ends of Fig. 124 to form a corkscrew weave. Suppose these ends are taken

in satin order on a base of 4. Then the weave shown in Fig. 125 will be formed. It will be seen that two repeats of the weave are shown in this figure, since the weave repeats on 7 ends.

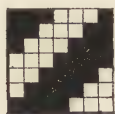


Fig. 124.



Fig. 125.

602. By re-arranging the *ends* of a weave in this manner, *warp corkscrews* are formed, while by re-arranging the *picks*, *filling corkscrews* are formed.

603. It should be stated here that corkscrew weaves cannot be formed by re-arranging the ends of every 45° twill, but that weaves such as shown in Fig. 124 lend themselves most readily to the formation of these weaves.

604. Figs. 126 and 127 show two 8 end twills, Fig. 126 being a regular 5 up and 3 down twill, and Fig. 127 is a regular 3 up and 5 down twill.

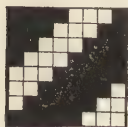


Fig. 126.

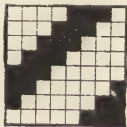


Fig. 127.



Fig. 128.

Suppose, for an illustration, that it is desired to combine these two twills end and end to form a corkscrew weave. Fig. 128 shows a weave formed in this manner, and it will be seen that the first end of Fig. 128 is the first end of Fig. 126, the second end of Fig. 128 is the first end of Fig. 127, the third end of Fig. 128 the second end of Fig. 126, the fourth end of Fig. 128 the second end of Fig. 127, and so on for the 16 ends.

605. By means of combining these two twills, the ends of which have different lengths of floats, it will be seen that the corkscrew twill is formed which will make twill lines of ribs across the cloth of *unequal* size. This will be readily seen by referring to Fig. 128, since all the odd numbered ends are up 5 picks and down 3, while the even numbered ends are up 3 picks and down 5, and since in these warp corkscrews it is the ends which show, it will be readily seen that the ribs must be of unequal size.

606. If it was desired to make filling corkscrews from regular twill weaves it would be simply necessary to combine them pick and pick instead of end and end as was the case in warp corkscrew weaves.



Fig. 129.

As was explained when dealing with cords, it will also be found necessary when weaving corkscrew twills, to have more ends than picks in warp corkscrews, and more picks than ends in filling corkscrews.

607. Another class of corkscrew weaves includes those known as warp corkscrews with filling effects. These weaves may be formed by taking the ends of any unequally flushed twill in such a manner as to form ribs in a twill line across the cloth and at the same time to show a distinct line of filling. Fig. 129 shows such a weave and is constructed by taking a regular 45° 7 end twill, $\frac{3}{3} \frac{2}{2} \frac{1}{1}$, drafting the ends 1-6-2-7-3-1-4-2-5-3-6-4-7-5.

EXAMPLES FOR PRACTICE.

608. 1. Make a twill weave with the base $\frac{3}{3} \frac{2}{2} \frac{1}{1}$.
2. From the weave given in answer to question 1 construct another weave by taking the ends in satin order, moving in sevens.

3. Construct a 15 end twilled basket.
4. Construct a cord weave which will make uneven cords across the cloth.
5. Construct a cord weave which will make even cords lengthways of the cloth.
6. Make a twill weave with the base $\frac{8}{7}$, and from this twill construct a warp corkscrew twill. State the order in which the ends of the twill are taken in order to form the corkscrew.

609. **Honeycombs** are very common weaves and are extensively used in making towels. When coarse yarns are employed in these weaves they make a spongy cloth well suited to this purpose.

It is possible to make honeycomb weaves on any number of harnesses from four upwards, but it will be found that the best examples of these weaves can be made on an *even number of harnesses*.

610. When making a honeycomb weave, the first thing to be decided upon is the number of harnesses to be used. Suppose, for an example, that it is desired to make a honeycomb weave on eight harnesses. *Raise all the ends, except the first, on any one pick of the weave.* It is best to make this pick near the centre of the design. A, in Fig. 130, will show this somewhat more plainly to the student. In this figure it will be seen that the first end on this pick is not marked, while the second, third, fourth, fifth, sixth, seventh and eighth ends are raised.

611. After having marked the pick in this manner, next form a spot by marking the risers in regular 45° manner from the first and last ends. B, in Fig. 130, shows a spot formed from A in this manner. After the spot has been formed, next run a line of risers around the spot, *having one blank space between these risers and the risers forming the spot*, and remembering that the weave must be complete on 8 ends and 8 picks. C, of Fig. 130, shows the honeycomb weave complete.

612. It will be seen that on the pick shown in A, which is the fourth pick in C, no mark can be placed in addition to the ends raised in the spot figure, since it is not possible to have a blank space between them, consequently, commencing with the next or the fifth pick, mark the first end, which will leave a blank space between this end and the first end marked in the spot figure on this pick. Running this up in regular 45° manner it will be seen that it stops on the fourth end on the eighth pick. Running these marks completely around the spot, it will readily be seen that C, in Fig. 130, is obtained.

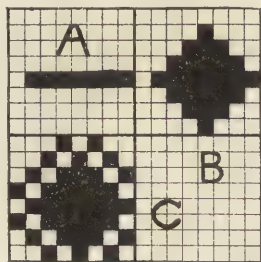


Fig. 130.

613. It should be stated here that honeycomb weaves may be formed in various ways, but as previously stated, weaves formed in the manner described here will form the best honeycombs, since, when constructed on other lines, the spot figure is not generally made symmetrical.

614. **Diagonal weaves** may be considered as a form of twill weaves. Regular diagonals are generally formed by combining two regular 45° twills in their picks or ends. As the formation of other weaves by combining twills, pick and pick, or end and end, have been fully explained in Part III. of Designing, it will not be necessary to give further details of these weaves, it being simply necessary to state here that all the examples given in Part III., under this method of forming weaves, may be considered as diagonals.

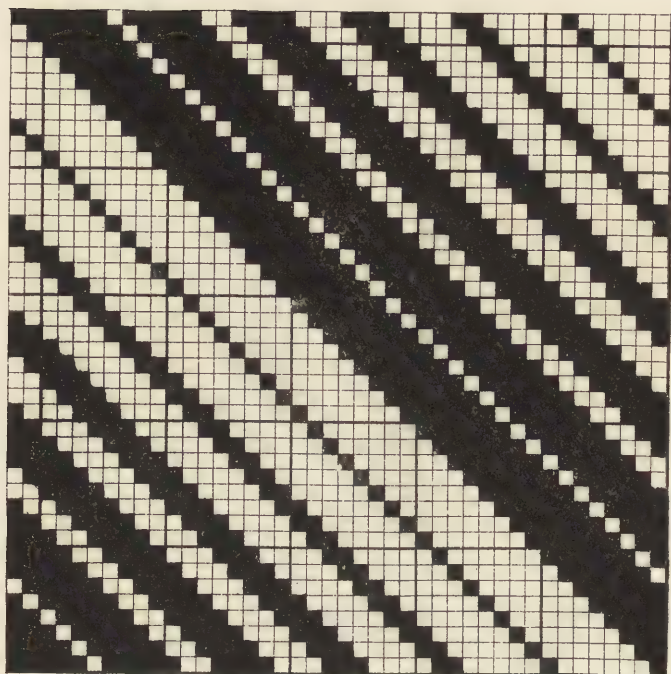


Fig. 131.

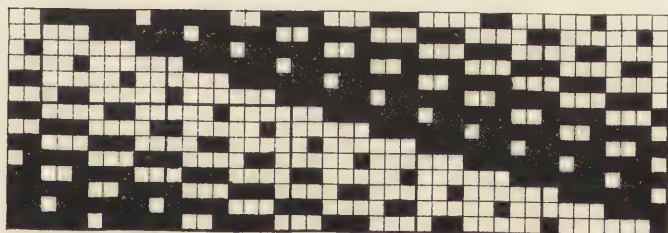


Fig. 132.

615. There is, however, a subdivision of these weaves known as **shaded diagonals** which will need a description here. These weaves are formed on a twill basis by taking as a base of the twill a different number of risers and sinkers in the different sections, grading from light to dark, or from dark to light.

616. An example of a shaded diagonal will make this somewhat clearer to the student. Suppose that a shaded diagonal is to be made from a regular 45° twill which is complete on 42 ends and picks. Divide the first pick of the weave into 6 different sections of 7 ends each. Then beginning with the first section leave only one end down. That is, this part would be marked $\frac{6}{1}$. In the next section leave two ends down, making this section $\frac{5}{2}$. Continuing in this manner the next section would be $\frac{4}{3}$, the next section $\frac{3}{4}$, the next section $\frac{2}{5}$, while the last section would be marked $\frac{1}{6}$, therefore the first pick of this weave would be marked as follows: $\frac{6}{1} \frac{5}{2} \frac{4}{3} \frac{3}{4} \frac{2}{5} \frac{1}{6}$.

617. It is next necessary to run this twill up in regular 45° manner until it is complete. That is, until it will occupy 42 ends and 42 picks.

Fig. 131 shows the complete weave. After the regular twill has been formed, it is next necessary to decide what angle the diagonal shall form. If it is to form a 63° twill every other end of the regular twill may be taken. If it is to form a 70° twill every third end of the regular twill will be taken, and so on.

618. Suppose that in this case it is desired to have the diagonal form a twill of 70 degrees. Then every third end of the regular twill as shown in Fig. 131 will be taken. It will be seen that 3 can be divided evenly into 42, which is the total number of ends which Fig. 131 is complete on. This will make the diagonal complete on $42 \div 3$, or 14 ends. Commencing then with the first end in Fig. 131 and taking every third end of the weave it will be seen that Fig. 132 will result.

619. Thus, the first end of Fig. 132 is the first end of Fig. 131, the second end of Fig. 132 is the fourth end of Fig. 131, the third end of Fig. 132 is the seventh end of Fig. 131, and so on until every third end of the regular twill has been taken. It will be readily seen by the student that Fig. 132 will form a

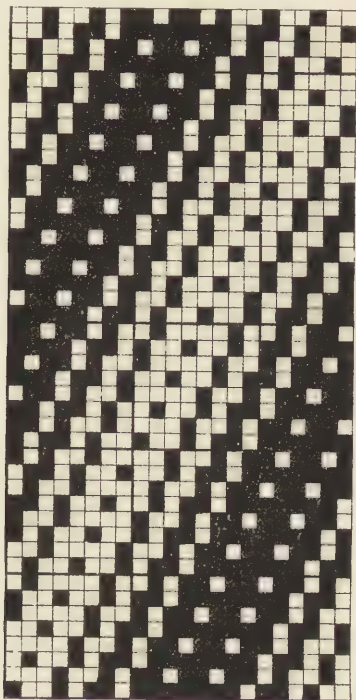


Fig. 133.

shaded effect in the cloth. That is, commencing with a certain part of the weave, a large part of the warp will be found to float on the surface. This is graded gradually until a point is reached where the filling will be found to predominate largely on the surface.

620. In many cases these diagonals are made to shade in both directions. That is, a line of warp floats will be found to

run up the cloth, and these floats will gradually grow less until the filling is found to predominate, when the weave will again be shaded until the warp predominates instead of breaking off suddenly, as is the case in Fig. 132.

621. In making this class of weaves it is necessary to start with a large number of floats of warp and work both ways with the base of a regular twill.

622. Fig. 133 shows a shaded diagonal, shaded in both directions, which is formed by taking every other end of a regular twill which has for its base $\frac{1}{4} \frac{2}{3} \frac{3}{2} \frac{4}{1} \frac{5}{1} \frac{4}{2} \frac{3}{3} \frac{2}{4}$. Considering the base of this twill, without any reference to Fig. 133, it will be seen that the largest float occurs in the centre where there are five ends up. Counting to the left from this point, it will be seen that this pick is arranged as follows: $\frac{5}{1} \frac{4}{2} \frac{3}{3} \frac{2}{4} \frac{1}{1}$, which is the same as explained previously, with the exception that the 5 ends down which would come last are omitted. This is done in order to give 4 ends down on each side of the 1 up. Commencing again with the 5 ends up and counting to the right, it will be found that this pick is arranged in exactly the same manner as when counting to the left, with the exception, however, that in this case the arrangement ends with 4 down. That is, there will be the following order: $\frac{5}{1} \frac{4}{2} \frac{3}{3} \frac{2}{4}$. The object of stopping with the 4 down is the same as that explained when counting to the left, that is, to allow 4 ends down on each side of the 1 up.

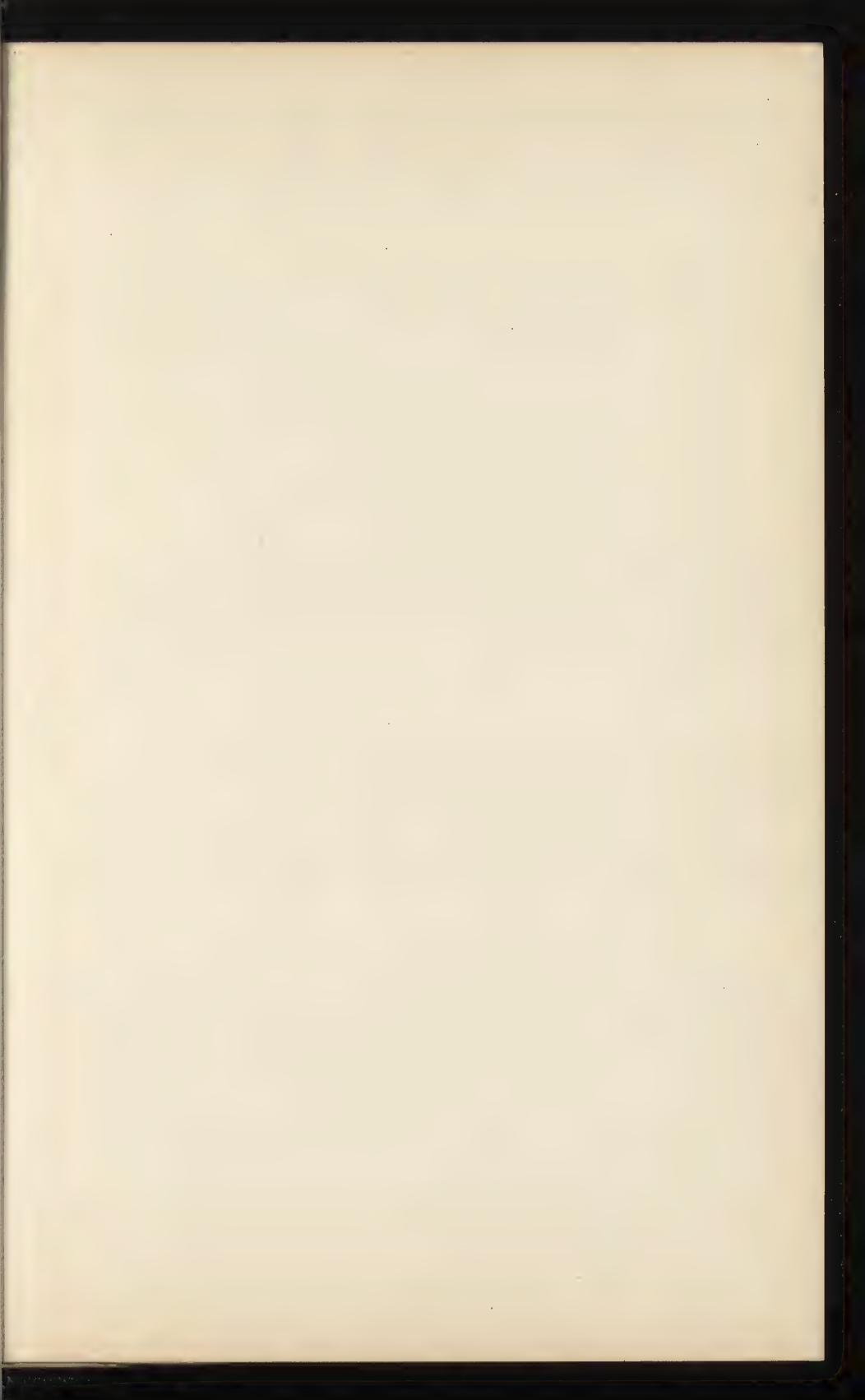
It would be well for the student to make the regular twill with this base, when it will be readily seen that Fig. 133 is formed by taking every other end.

EXAMPLES FOR PRACTICE.

- 623.** 1. Construct a honeycomb weave on 10 harnesses.
2. Make a regular twill weave from the base $\frac{4}{1} \frac{3}{2} \frac{2}{3} \frac{1}{4}$.
3. From the weave given in answer to question 2 construct a 63° shaded diagonal.

4. Extend the base of the twill given in question 2, and from the twill formed by this new base, construct a shaded diagonal which will be shaded in both directions.

5. Make a honeycomb weave on 14 harnesses.





COMBINATIONS OF WEAVES.

624. As has been stated in one of the earlier parts of Designing, the number of what are known as fundamental weaves is very small, but the weaves which may be obtained from these are practically innumerable.

625. One class of weaves obtained from the regular weaves includes those weaves known as derivatives, and these have been fully explained. To this class belong those weaves which are made by re-arranging the ends or picks of any regular weave or by combining two or more weaves end and end or pick and pick.

626. Still another method of forming new weaves, and the one which this lesson will deal with very largely, is that of combining weaves as a whole, or as it is known to the designer, the *combinations of weaves*.

627. Designs formed on this principle are met with very frequently, and in all cases where a neat figured effect is required, especially in cloths having the same color of yarns in both warp and filling, this method of constructing designs is invariably adopted.

628. As every weave, whether a twill, basket, satin, corkscrew, or any other, produces an entirely different effect in the woven cloth, it will be readily seen that a very large field for the production of new effects is accessible by this means of forming weaves.

629. In the formation of these weaves there are several important points which should always be taken into consideration, and these will be brought to the student's notice before the methods of forming the weaves are explained.

630. In the first place, the yarns with which the cloth is to be woven, whether wool, worsted, silk or cotton, must be considered.

631. If the yarn is woollen, the weaves must be regular in structure, as woollen yarn is so constructed that it is not specially adapted for developing weave effects, the surface of the yarn being too rough and fibrous. Simple combinations and good colorings are the essential points in woolens.

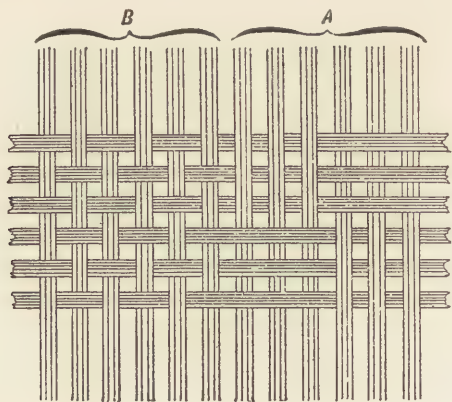


Fig. 134.

632. In worsted or cotton fabrics, a large diversity of fancy weaves may be used, since the yarns are comparatively smooth, the fibres being laid in a parallel order, and the yarns are excellently adapted for bringing out every detail of a design. Silk is a still more suitable yarn for developing weave effects.

633. The second point to be noticed, and the one which it is especially desired to call the student's attention to, is, that however widely the weaves which are to be combined may differ in respect to the effects which they produce on the face of the cloth, they must be somewhat similar as regards the number of interlacings of the warp and filling, otherwise they cannot be made to weave regularly together.

634. When desiring to form new effects by the method of combining two or more weaves, this latter point should constantly be borne in mind, as it is absolutely essential to the satisfactory weaving of the cloth.

635. The importance of this point may be somewhat better understood by referring to Fig. 134, which is a representation of a sample of cloth supposed to have been made by combining two weaves without regarding the number of interlacings of warp and filling.

636. In this figure each set of four lines running vertically represents one end, while each set of six lines running horizontally represents one pick. It will readily be seen that the ends in section A are interlaced on the six end basket principle, while those in section B are working plain.

637. It will also be noticed that by this method of interlacing, the ends in section A interlace with the filling twice during the six picks shown in this figure, while the ends in section B interlace six times during the same number of picks, thus causing the ends in section B to have three times as many interlacings as the ends in section A.

638. The result of this will be a tendency to prevent the picks of section B from being as closely pressed against each other as those in section A where the interlacings are not as frequent.

639. The reason of this will be readily apparent. In section B the warp yarns change positions every pick, therefore they lie between one pick and the pick following, separating these by the distance represented by the diameter of the yarn, thereby preventing each pick from being beaten up against the preceding pick.

640. In section A there is nothing to prevent one pick from being beaten up against the other, where the picks are three in a shed, supposing, of course, that this weave was being used alone irrespective of the weave used in section B;

but on the third and fourth, and also on the first and sixth picks the warp yarns change positions, and those lying between the third and fourth picks prevent these picks from being beaten up against each other, while the same is true of the sixth and first picks.

641. From this it will be seen that the more frequently the warp and filling cross each other, the greater difficulty there will be in driving each pick of filling closely against the preceding one; consequently if the picks were beaten up close together in section A, the warp ends in section B being turned from a straight line to a very great extent more than those in section A, would therefore take up faster and consequently work tighter during weaving, which would soon produce a cockled or wrinkled appearance.

642. On the other hand, the more open the weave, the closer can the filling be inserted. As three ends of warp are depressed or elevated during three picks in succession in section A, this portion of the cloth admits the filling much more freely.

643. For these reasons, closely woven and open flush weaves should rarely, if ever, be combined if the warp yarns are all run from the same beam, as they can be made to weave only with great difficulty. There are some instances where the flushes may be varied without detriment to the regularity of the fabric, but these are rather the exception than the rule.

644. An example of this kind would be in figured designs where the various parts are not continuous from one end of the piece to the other, but where a weave is simply introduced for a number of ends and picks in order to give character to the figure in the design. In such cases the diversity of flush in the weaves employed is sometimes very large.

645. For general combinations, however, the weaves, although they may be decidedly different from each other as regards the effects they produce in the woven fabric, should, if

possible, be similarly constructed as regards the number of interlacings of the warp and filling.

646. It should always be remembered in textile designing that the ends and picks have to interlace and form a build or structure of fabric in addition to producing a design. Therefore the practicability of a design as regards its weaving should always be as carefully considered as its practicability as regards its looks.

647. The first class of weaves, formed from combinations of weaves, which will be dealt with in this lesson, is that which consists of the weaves known as **stripes**.

648. The most elementary form of the stripe design results from combining the warp prunelle with the filling prunelle. Fig. 135 is a stripe design on 18 ends, resulting from combining these two weaves.



Fig. 135.

649. By referring to this figure the student will readily see that the first fifteen ends are made by repeating the warp prunelle $2\frac{1}{1}$ five times, while the last three ends are the filling prunelle $\frac{1}{2}$.

650. In all the illustrations of combinations of weaves all marks indicate warp lifted unless otherwise stated. Where different kinds of marks are used, the object is to show more clearly the different weaves which are combined.

651. One important point should be carefully noted here by the student, which is that in combining weaves in this manner, it is always best, wherever possible, to *make the weaves cut where they oppose each other*.

652. By "cutting" is meant that where the weaves join, the warp floats of one weave will come against the filling floats of the other, and the filling floats against the warp floats.

653. By noticing Fig. 135 it will be seen that this has been done in this case. Thus, the fifteenth end is the last end of the warp prunelle, while the sixteenth end is the first end of the filling prunelle, and it will be seen that on those picks on which the fifteenth end is raised the sixteenth end is lowered, while on those picks on which the fifteenth end is lowered, the sixteenth end is raised.

654. But it will be noticed that there is another joining point of these two weaves besides the fifteenth and sixteenth ends. If the weave should be repeated in its ends it would be seen that the *first end* would come next to the *last end*. Therefore when seeking to have weaves cut where they are joined, this point should be as carefully considered as the former.



Fig. 136.

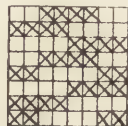


Fig. 137.

655. It will be seen that Fig. 135 complies with these requirements, since on those picks on which the last end is raised the first end is lowered, while on those picks on which the last end is lowered the first end is raised.

656. The student should clearly understand that each weave should run up in regular order, and that they should not be made irregular for the purpose of making the weaves cut, although they may be commenced on different ends and picks.

657. Still another point which should be taken into consideration when combining weaves, is to always try to so combine the weaves that the warp and filling floats will not be any longer in the new weave than they were in the weaves from which this weave was formed.

658. To illustrate this point, suppose it is desired to combine the two weaves shown in Figs. 136 and 137. In the first case,

they will be combined just as they are, that is, by copying the eight ends of Fig. 136 for the first eight ends of the new weave, and copying the eight ends of Fig. 137 for the last eight ends of the new weave.

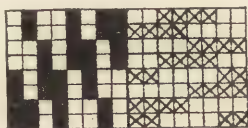


Fig. 138.

659. Fig. 138 shows the weave formed by combining the two weaves by this method. It will be noticed by referring to this figure that on the third pick there is a filling float of six ends, while in neither of the weaves which were combined was there a filling float of more than four ends.

660. Also on the seventh pick it will be noticed that six ends are raised side by side, while in neither of the weaves combined were there more than four ends up together on the same pick. It is such points as these which should be constantly watched for when making weaves of this class.

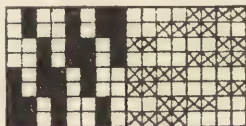


Fig. 139.

661. Fig. 139 shows these same two weaves combined, but in this case it will be noticed that on no pick does the filling float over a greater number of ends than it did in either of the weaves combined, neither are more ends raised together on any one pick.

662. It will be seen that in this figure the first eight ends are Fig. 136 taken just as they are, while the last eight ends

are Fig. 137, commencing with the seventh end and taking the ends in regular order.

663. That is, the

9th end of Fig. 139	is the 7th end of Fig. 137
10th " " "	139 " " 8th " " " 137
11th " " "	139 " " 1st " " " 137
12th " " "	139 " " 2d " " " 137

and so on.

664. It should be stated here that it is not always absolutely necessary, nor in fact is it always possible, to so combine two weaves that they will cut perfectly and not have any larger floats than when not combined, but as previously stated, it should always be the student's aim to seek the best manner of making these weaves, and it should be constantly borne in mind that when these points are complied with, the resulting weave shows a much better design in the cloth.

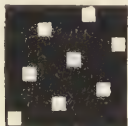


Fig. 140.

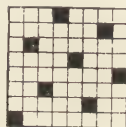


Fig. 141.

665. A description of the formation of a few of these weave combinations will be given here in order to better enable the student to understand the method employed.

666. One method of making these weaves, and one which is as satisfactory as any for certain classes of weaves, is to combine two weaves, one of which is the reverse of the other in regard to the warp and filling flushing. These weaves can always be made to cut where they are joined.

667. Thus, for example, suppose that two eight end satin weaves are to be combined on this basis.

Fig. 140 shows an 8 end warp satin moving on a base of 3, while Fig. 141 shows an 8 end filling satin, moving on a base of 5.

668. In making a combination weave from warp and filling satins, in order to have the weaves cut it is necessary to have the *sum of the numbers used for the base of each satin equal the number of ends on which each satin weave is complete.*

669. Thus in the case of Figs. 140 and 141, the warp satin moves on a base of 3, while the filling satin moves on a base of 5, and $5 + 3 = 8$, which is the number of ends on which each satin weave is complete.

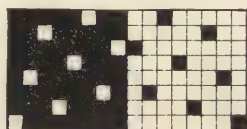


Fig. 142.

670. It is next necessary to combine these two weaves in such a manner that they will cut. It will be readily seen that if they were combined just as they are shown in Figs. 140 and 141, the desired results would not be obtained, therefore it will be necessary to start one of the weaves on either a different end or a different pick.

671. By carefully considering these two weaves it will be seen that by copying Fig. 140 just as it is for the new weave, and starting Fig. 141 on the second end, the weaves will be made to cut. Fig. 142 shows these two weaves combined in this manner.



Fig. 143.



Fig. 144.

672. Dealing with the second section of Fig. 142 alone, it will be seen that the ninth end is the second end of Fig. 141, the tenth end is the third end of Fig. 141, the eleventh end is the fourth end of Fig. 141, and so on.

673. Another good method of forming combination weaves by means of combining warp and filling flush weaves is to combine two twill weaves, in one of which the warp flushes to an extent equal to the filling flushes of the other weave.

674. Figs. 143 and 144 are two such twill weaves, and it will be readily seen that by combining them as shown in Fig. 145, they form a weave which cuts perfectly where the two weaves are joined. It will also be noticed that in Fig. 145 both of the weaves which are combined have been repeated in both ends and picks.

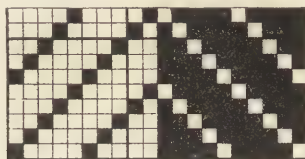


Fig. 145.

675. By referring to these figures it will also be noticed that the twill in one runs in a direction opposite to the twill in the other. Thus, the twill in Fig. 143 runs to the right, while the twill in Fig. 144 runs to the left. It will always be found necessary when combining twills in this manner, to have the twills *run in opposite directions* in order to have the weaves cut.



Fig. 146.

676. Very frequently stripe weaves will be found to be formed by drafting an equally flush twill other than straight, instead of combining two weaves. As stripe weaves are being dealt with in this lesson in connection with combinations of weaves, it will be as well to give a short description of stripe weaves formed by this method.

677. Fig. 146 shows a stripe weave made in this manner.

By referring to this figure it will be seen that the first four ends are the cassimere twill $\frac{2}{2}$, the next two ends are the second end of the cassimere twill, the next two are the fourth end of the cassimere, the next eight are the regular twill com-

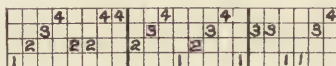


Fig. 147.

mencing with the second end, the next two are the third end of the cassimere, and the next two are the first end, while the last two are the cassimere twill commencing with the third end and running in regular order. It will be noticed that in all places where this weave changes, the ends cut.

678. It will further be noticed that every end in Fig. 146 is a certain end of the cassimere twill, and yet by combining them in this manner, a perfect stripe is formed in the cloth. This weave could be made on four harnesses, and the harness draft for the weave on this number of harnesses is shown in Fig. 147.

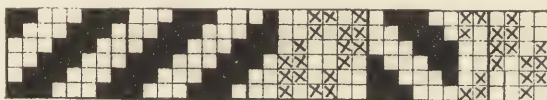


Fig. 148.

679. Fig. 148 is another stripe weave formed in this same manner from the equally flush twill $\frac{3}{3}$. It will be seen by referring to this figure that the first eighteen ends of this stripe design are formed by running the regular twill $\frac{3}{3}$ in regular order, the next two ends are the third and fourth ends of the twill, the next two are the first and second, and the next two are the fifth and sixth.

680. The next six ends are the regular $\frac{3}{3}$ twill with the twill running in the opposite direction, and commencing with

the third end. The next two ends are the first and second ends, the next two are the fifth and sixth, while the last two are the third and fourth.

681. It will be noticed again in this case that each end in Fig. 148 is a certain end of the regular $\frac{3}{3}$ twill, and consequently it is possible to weave this design on six harnesses. The harness draft for this weave on this number of harnesses is shown in Fig. 149. It will be seen that the draft shown in Fig. 149 is a good example of skip drafts which were explained in Part I, of Designing.

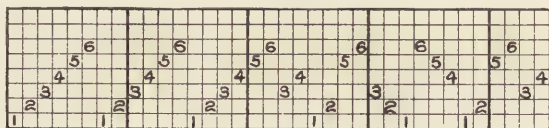


Fig. 149.

682. Fig. 150 is another weave of this class, and the student should be able to readily pick out the method of its construction without any further explanations.



Fig. 150.

683. Another method of forming these stripe designs, and one which is quite generally adopted, is that of running a regular equally flushed twill up for a certain number of ends and then reversing the weave, but commencing with an end which will cause the weave to cut where it is reversed.

If the student remembers the descriptions of different drafts which were given in Part I. of Designing, it will be noticed that a regular equally flushed twill weave with an angled draft will give the same result.

684. Fig. 151 shows a weave of this class, while Fig. 152 gives the harness draft, which it will be noticed, is an angled draft.

685. It will be noticed that in Fig. 151 the weave is repeated in its picks, since 16 picks are shown here, although the weave is really complete on 16 ends and 8 picks.

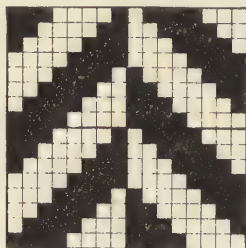


Fig- 151.

686. At the ninth end the weave reverses, and it will be seen that this ninth end is the same as the fourth end, thus causing the weave to cut at this point, as the warp and filling floats of the eighth end oppose the warp and filling floats of the ninth end.

687. It will further be noticed that the warp and filling floats of the first end also oppose the warp and filling floats of the last end, thus causing the weave to cut at this point, since these two ends come together in the cloth.

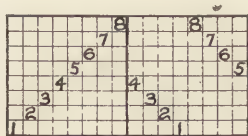


Fig. 152.

688. It will be remembered that this has previously been spoken of as a point always to be taken into consideration, since it is as essential to have these two ends cut as it is to have the ends in the centre of the weave cut.

689. The width of the different stripes can readily be changed by *repeating any section of the drawing in draft a certain number of times.*

690. Thus, if the first eight ends of the drawing in draft were repeated four times, and the last eight ends were not repeated, then the first stripe would be on thirty-two ends and the last stripe on eight ends, the whole weave being complete on forty ends, although it would require only the same number of harnesses to weave it, namely, eight.

691. By changing the drawing in draft in this manner, a large number of different weaves can readily be formed, and by changing the twills in the weave, a still greater variety can easily be obtained.

692. Another class of stripe designs which is met with quite frequently, includes weaves known as **single end stripes**. These weaves are generally formed by opposing a warp flush twill with a single end of a filling flush twill, or by opposing a filling flush twill with a single end of a warp flush twill, having the ends cut where the two weaves oppose each other.

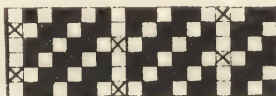


Fig. 153.

693. Fig. 153 illustrates one type of these designs. By referring to this figure, the student will readily see that the first end is a filling flush weave, the next six ends are the regular warp twill $\frac{2}{1}$, the next end is the filling flush, the next six are the $\frac{2}{1}$ twill, the next end is the filling flush and the last three are the $\frac{2}{1}$ twill.

694. It will be noticed that the two weaves, where they are combined, cut on both sides, and it will also be noticed that in order to accomplish this, it is necessary to have *the end on one*

side of the single end of the filling flush, exactly like the end on the other side.

695. Thus, in Fig. 153 it will be seen that the seventh and ninth ends are the same, also the fourteenth and sixteenth, and again the second and eighteenth.

EXAMPLES FOR PRACTICE.

696. 1. Make a stripe design on 12 ends, by reversing the 6 end twill $\frac{3}{3}$. Have the weaves cut where they reverse.

2. Make a single end stripe design on 20 ends, using the 4 end twill $\frac{3}{1}$.

3. Make a stripe design on 14 harnesses, using warp and filling flush satins. Have the weaves cut where combined.

4. Make a stripe design on 20 ends, using the 5 end warp and filling satins repeated in the ends.

5. Give a harness draft which would give a stripe effect in the cloth when using the $\frac{6}{6}$ twill for a chain draft.

697. Check weaves may be made in a variety of ways, many of these weaves having a twill or satin base. In many cases the figure on one part of the check will be found to be produced by the warp, while the figure on the other part will be produced by the filling.

698. Check weaves, to a certain extent, may be considered as simply extensions of stripe weaves, and it has been previously explained how a stripe may be formed in the cloth by opposing one weave with another.

699. If, after this is done, the weave should be extended in its picks, taking pains to have the picks oppose each other in the same way as the ends were opposed in the stripe weave, then the resulting figure would form a check in the cloth. An illustration of this method will no doubt make this somewhat plainer to the student.

700. Suppose, for an example, that it is desired to make a check weave, using the regular equally flushed weave shown in Fig. 154 as a base.



Fig. 154.

701. Each step in forming a check from this base will be fully explained here, and by following the descriptions closely, the student should have no difficulty in understanding this method of making these weaves.

702. First, it is necessary to form a stripe design from the regular twill given in Fig. 154. As the method of forming these weaves has been fully explained, it will not be necessary to further describe them here, but it should be stated that if the student has not a good understanding of the methods of forming stripes, the descriptions previously given should be carefully studied again, as the whole formation of a check is simply the extension of the stripe, as previously stated.



Fig. 155.

703. Fig. 155 shows the stripe design formed from the regular twill shown in Fig. 154.

It will be seen that the formation of this weave agrees with the descriptions previously given, and that the harness draft for this weave would be an angled draft.

704. The next step in the formation of the check is to consider the stripe, as shown in Fig. 155, as two separate sections, that is, the first six ends would be one section, and the last six would be another section, after which extend each section in its picks, taking care to have the weaves cut in the picks the same as in the ends when forming the stripe.

705. In other words, extend each section in such a manner that it would form a stripe across the cloth instead of lengthways of the cloth.

706. Fig. 156 shows the first six ends extended in this manner, while Fig. 157 shows the last six ends extended.



Fig. 156.



Fig. 157.

707. By carefully noting either Fig. 156 or 157, it will be seen that the weaves cut perfectly in their picks, thus, it will be noticed that in both weaves the sixth pick opposes the seventh, and also that the first and last picks oppose each other.

708. The student should understand that in actual practice the picks in each of the two sections of the weave, as shown in Fig. 155, would be run up without separating the weaves as has been done here, this having been done simply to make the process clearer. Therefore the complete check weave would be the weave as shown in Fig. 158, which is Figs. 156 and 157 brought together.

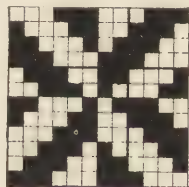


Fig. 158.

709. One important point should be noted in connection with Fig. 158, which is that the weave cuts all around. By carefully considering this weave, it will be seen that the sixth pick opposes the seventh pick, the sixth end opposes the seventh end, and further, the first and last picks, also the first and last ends, oppose each other.

This feature should always be present in all check weaves formed in this manner.

710. It will further be noticed that the same harness draft which would be used in connection with the weave shown in Fig. 155 would also be used for the weave shown in Fig. 158. Therefore, in actual practice, when it is desired to change a stripe weave to a check, all that is necessary is to simply *alter the chain draft to give the desired effect.*

711. The student will remember that when describing stripe weaves, it was stated that the size of the stripe could be enlarged to any desired extent by simply altering the drawing in draft.



Fig. 159.

712. The same rule will hold good when dealing with checks formed in this manner, with the exception that, in this case, the chain draft must also be altered, that is, the size of the check may be increased as desired by means of changing the drawing in draft and chain draft to suit the requirements.

Fig. 159 illustrates this method of enlarging a check design.

713. By referring to this figure it will be seen that it has been formed by simply extending each section of Fig. 158 in both ends and picks. Take, for example, the section occupying the lower left hand corner in both Figs. 158 and 159.

714. It will be seen that both of these weaves are the same, the only difference being that while in Fig. 158 the weave occupies 6 ends and 6 picks, in Fig. 159 it occupies 12 ends and 12 picks.

715. The same has been done with each of the four sections in Fig. 158, thus causing the new weave to occupy 24 ends and 24 picks, where it originally occupied but 12 ends and 12 picks.

716. It will further be noticed that the weave shown in Fig. 159 can be made on six harnesses, which is the same number that Fig. 158 can be woven on.

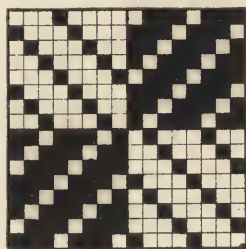


Fig. 160.

717. As previously explained when dealing with stripes, these weaves may be formed in a variety of ways, not only by equally flushed twills, but also by opposing a warp flush twill with a filling flush twill.

718. The same is equally true of checks, and consequently a check design may readily be formed from a stripe design which has been obtained by combining warp and filling flush twills. Fig. 160 is an example of this type of check designs.

719. By considering only the first eight picks of this design, it will readily be seen that this part of the figure alone, forms a stripe design and is obtained by combining the warp flush twill $\frac{3}{1}$ with the filling flush twill $\frac{1}{3}$.

720. The next eight picks of this design are formed by opposing the lower section of the warp flush with the filling flush

weave, and also opposing the lower section of the filling flush with the warp flush weave. It will also be noticed in connection with this weave that it cuts perfectly at all points, which as previously stated, is a very essential point in these cut check weaves.

721. Warp and filling satin weaves, as explained previously, are often combined to form stripe weaves, and these also may be extended to check weaves, and made to cut at all points. Fig. 161 is an example of a cut check weave made from warp and filling satins.

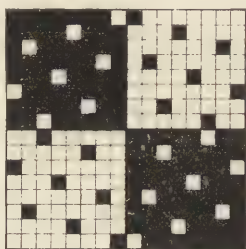


Fig. 161.

722. When combining weaves of this class to form a check, the explanations given for stripe weaves made by combining satins, should be carefully noted, especially with regard to the relation that the base of the warp satin should bear to the base of the filling satin, in order to make the weaves cut at all points, and also with regard to starting the weaves on certain ends and picks for the same purpose.

723. By noting Fig. 161, it will be seen that the eighth and ninth ends, and the first and last ends, also the eighth and ninth picks, and the first and last picks cut perfectly, since in each case the warp and filling floats of one weave oppose the warp and filling floats of the other weave.

724. The student will find it to be of great advantage to himself to practice making these weaves, as well as all weaves

which are explained in these lessons, as it is only by this means that a person can become familiar with the methods explained.

725. In making a check weave, it is simply necessary to decide first upon the weave which is to form the base, and run this weave up for as many ends and picks as desired. Then from this weave form a stripe design, by following the explanations given for stripes, afterwards extending the weave in its picks to form a check, always being careful, however, to see that the weaves cut at all points. Check weaves constructed after the manner of Figs. 160 and 161 are known as **Diaper** weaves.



Fig. 162.



Fig. 163.

726. Another method of forming checks is by means of what is termed **reversing** or **transposing**. This method consists of taking any simple weave as a base and combining it with a weave which contains filling floats where the original weave has warp floats, and warp floats where the original has filling floats.

727. Combining these weaves will make a stripe from which a check may be formed by reversing or transposing the stripe design in the same manner as the original weave was transposed to obtain the stripe.

728. To illustrate this method of forming checks, suppose that it is desired to form a check weave, using the weave shown in Fig. 162 as a base.

729. It will be seen that this figure occupies 5 ends and 5 picks, then on the design paper, taking the next 5 ends and 5 picks, *moving across the paper, fill in those squares which correspond with the squares left blank in the original figure, and also leave those squares blank which were filled in, in the original figure.*

730. In order to make this somewhat plainer to the student, the weave will be made from Fig. 162, keeping them separate, although in reality they should be combined when making the stripe design, as the student will readily understand.

731. Fig. 163 shows the weave obtained by transposing the weave shown in Fig. 162. It should be stated here that in transposing a weave in this manner to form a stripe, the *first* end of the new weave is to be the reverse of the *last* end of the original weave, the *second* end of the new weave is to be the reverse of the *next to the last* end of the original, and so on.

732. Bearing this point in mind then, the student should consider Figs. 162 and 163.

It will be seen that the last, or fifth end of Fig. 162, is lowered on the first and second picks, raised on the third pick, and lowered on the fourth and fifth picks.



Fig. 164.

733. Again it will be seen that the first end of Fig. 163 is exactly the reverse, since it is *raised* on those picks on which the fifth end is *lowered*, and is *lowered* on those picks on which the fifth end is *raised*.

734. Taking next the *fourth* end of Fig. 162 and the *second* end of Fig. 163, it will be seen that they are exactly the reverse, since on those picks on which one end is raised, the other end is lowered, and also on those ends on which one end is lowered, the other end is raised.

735. The same is true with the *third* end of Fig. 162 and the *third* end of Fig. 163; with the *second* end of Fig. 162 and the *fourth* end of Fig. 163; with the *first* end of Fig. 162 and the *last* end of Fig. 163.

736. Thus, if these two weaves were combined to form a stripe, they would be found to cut perfectly. Fig. 164 shows the stripe design formed in this manner.

737. It next becomes necessary to form a check design from the stripe shown in Fig. 164. In order to form this weave, the stripe must be extended in its picks by reversing the picks.

738. This will be dealt with in the same manner as when forming the stripe from the original weave. Fig. 165 shows the weave formed from the stripe and which has to be combined with the stripe to make the check.



Fig. 165.

739. By carefully considering this weave, the student will see that it is formed by reversing the *picks* of Fig. 164 in the same manner as Fig. 164 was formed by reversing the *ends* of Fig. 162.

740. Thus, it will be seen that the *first* pick of Fig. 165 is the reverse of the *last* pick in Fig. 164, the *second* pick of Fig. 165 is the reverse of the *fourth* pick of Fig. 164, the *third* pick of Fig. 165 is the reverse of the *third* pick of Fig. 164, and so on for all the picks.

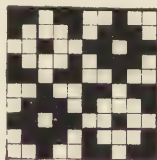


Fig. 166.

741. Next by combining these two weaves, the check design, as shown in Fig. 166, is obtained, and the student will readily notice that this weave cuts at all points.

742. Fig. 167 is another base from which to form a check weave after the manner described, while Fig. 168 shows the weave completed after this method.

743. It will be noticed that this weave also cuts at all points. This is a point which should always be carefully noted in connection with these weaves. By carefully studying these weaves, the student will no doubt understand the method of their construction without any further explanation.

744. As stated previously, check weaves will be found to be produced by a variety of methods, and it should be understood by the student that in all cases it is not necessary to have the different weaves, which form the check, cut perfectly, although much neater and clearer effects are produced when this is the case.



Fig. 167.

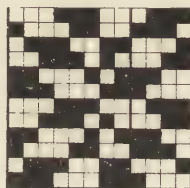


Fig. 168.

745. Another method of forming check weaves is that of combining different weaves in such a manner that distinct weaves will be formed in the cloth, these different weaves to be so arranged that the whole will produce a check.

746. Fig. 169 shows a check weave formed in this manner. By referring to this figure it will readily be seen that the whole figure may be divided into four distinct parts, namely, the lower left hand corner, the lower right hand corner, the upper left hand corner, and the upper right hand corner.

747. It will be seen that the weave in the lower left hand corner is the regular five end twill $\frac{3}{2}$, repeated twice in its ends and three times in its picks. It will also be noticed that the weave in the upper right hand corner is the same, but instead of occupying the same number of ends and picks, in this case it is repeated three times in its ends and twice in its picks.

748. The weave in the upper left hand corner is a five end basket, repeated twice in both ends and picks, while the weave in the lower right hand corner is a different five end basket, repeated three times in both ends and picks.

By means of combining these different weaves in this manner, a distinct check effect is formed in the cloth, although these different weaves do not cut perfectly where they are joined. It will further be noticed that although this weave occupies twenty-five ends and picks, it is possible to draft it down to ten harnesses.

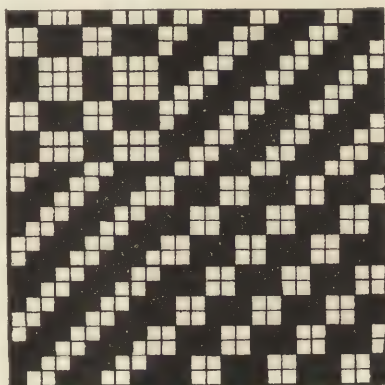


Fig. 169.

749. Various check designs may be formed by combining different weaves in this manner, but when forming checks by this method, care should be taken to combine only those weaves which will form good connecting places, and also to combine the weaves in such a manner that the floats of warp or filling will not be any longer than can possibly be helped.

750. Check weaves are also sometimes formed by combining twill weaves which form different angles in the cloth. Fig. 170 is an example of this class of weaves. It will readily be seen that this check is formed by combining weaves which run at different angles. It will also be noticed that one of the

weaves shows more warp on the face than the other, thus increasing the effect of the check.

751. It will readily be seen that the check weave shown in Fig. 170 may be said to be formed on the same principle as that described when dealing with checks formed by combining different weaves, and consequently these weaves need no further description, if the student bears in mind the points previously mentioned.

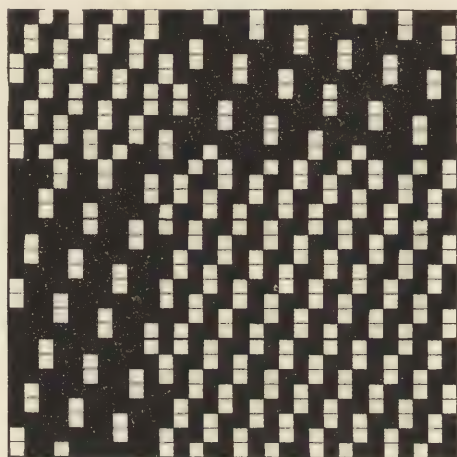


Fig. 170.

752. Many weaves, especially those which occupy a large number of ends and picks, are formed from what are termed **motives**. The word motive, when used in connection with designing, may be said to imply a base or plan for a design.

753. In constructing a weave from a motive, the appearance or effect which it is desired to produce in the cloth, is first shown on the design paper by means of filling in certain squares, and leaving others blank. From this, the desired weave is made by considering the filled in squares of the motive as one weave, and also the blank squares of the motive as another weave.

754. An example will no doubt make this somewhat clearer to the student.

It will be assumed that Fig. 171 shows a motive from which it is desired to produce a design which will be complete on 16 ends and 16 picks.

755. It will be noticed that the motive occupies 4 ends and picks, and it should also be borne in mind that the filled in squares and the blank squares of the motive represent two distinct weaves.

756. The first item always to be determined when constructing a weave from a motive, is the *number of ends and picks the weave, which is represented by each square of the motive, occupies.*



Fig. 171.

757. Thus, it will be noticed that the constructed weave is to occupy 16 ends and 16 picks, while the motive occupies 4 ends and 4 picks. Therefore, each square of the motive must represent 4 ends and 4 picks of the constructed weave, ($16 \div 4 = 4$), or in other words, the weave which each square of the motive represents, must occupy exactly 4 ends and 4 picks, in order to make the constructed weave complete on 16 ends and 16 picks.

758. It will be assumed that each blank square of the motive represents the filling *crow twill* $\frac{1}{3}$, while each filled in square of the motive represents the warp *crow twill* $\frac{3}{1}$.

759. It now remains to combine these weaves in such a manner that they will occupy the same relative positions in the constructed weave, that the filled in and blank squares occupy in the motive.

Fig. 172 shows the weave made in this manner from the motive, as shown in Fig. 171.

760. By carefully considering Figs. 171 and 172, it will be seen that the square in the lower left hand corner of the motive is blank, therefore, the first *four* ends and picks of Fig. 172 are composed of the filling crow twill.

761. The next square of the motive, counting across the page, is marked, therefore, the next four ends and picks of Fig. 172 are composed of the warp crow twill.

762. It will be readily seen that this method is continued throughout the weave, and the effect of this weave, when produced in the cloth, will be similar to the motive as shown in Fig. 171.

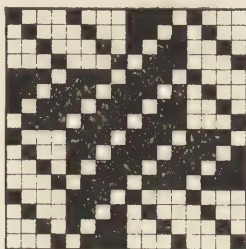


Fig. 172.

EXAMPLES FOR PRACTICE.

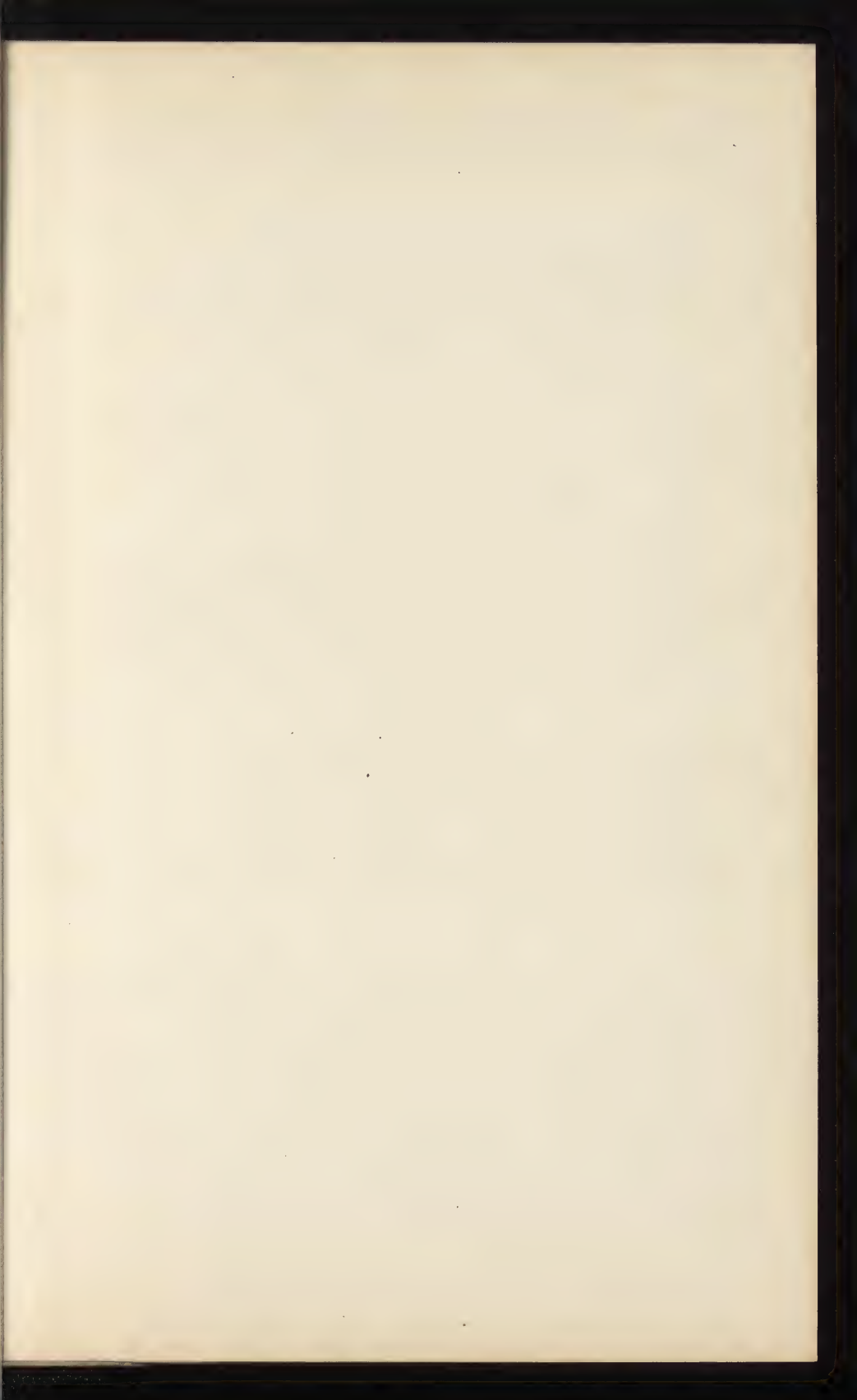
763. 1. Make a check weave with the twill $\frac{4}{4}$, having the check weave occupy 16 ends and 16 picks.

2. Enlarge the weave given in answer to question 1, so that it will occupy 32 ends and 32 picks.

3. Form a check weave with a 5 end warp flush and a 5 end filling flush satin.

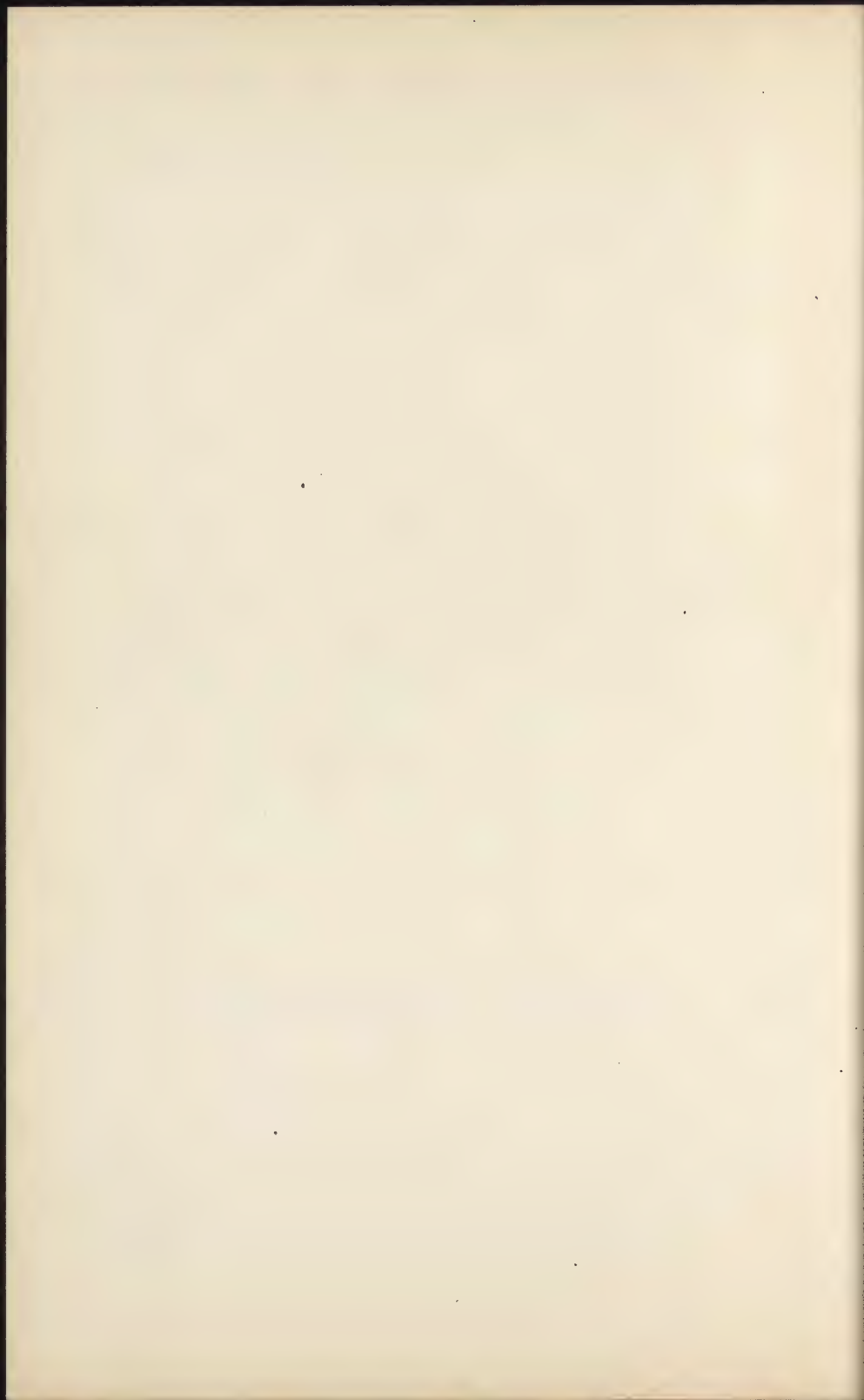
4. Form a check weave by reversing the weave given at C 5, in the alphabet of weaves.

5. Consider the weave shown at C 2, in the alphabet of weaves, as a motive, and from this construct a weave, using the $\frac{1}{4}$ twill for the filled in squares of C 2, and the $\frac{4}{1}$ twill for the blank squares.









SPOT WEAVES.

764. The weaves which have been described in previous lessons, may be said to be either fundamental weaves, or weaves derived directly from them. The weaves which will be described in this lesson may be considered as a slight deviation from those which have previously been pointed out, although the student should constantly bear in mind that such fundamental weaves as twills, satins, and so forth, play an important part in the drafting of any weave.

765. Spot weaves may be said to be formed in almost every instance by bringing a certain series of yarn, either the warp or the filling, to the surface of the cloth at certain points and letting it float for a number of ends, or picks, thus producing a spot effect on the cloth.

766. The manner in which the yarn is allowed to float on the face will determine the shape and appearance of the spot, as will be described later in this lesson.

767. When the yarn which forms the spot is the same as that which forms the rest of the cloth, or the *body* of the cloth as it is known, it will be readily seen that the color of the spot, or figure, must be the same as the rest of the cloth. In such cases there is but one system of warp or filling.

768. In many cases, however, when desiring to make a spot figure, an **extra warp** or an **extra filling** is used, which floats at the back of the cloth, except when it is desired to produce the spot, when it is brought to the face.

769. In such cases a different material may be used for the extra warp or filling, and the spot will be produced by

yarns entirely different from those which form the body or *ground* weave of the cloth.

770. When producing spots or figures by means of an extra warp or filling, the extra yarn is adopted simply for *figuring* the face of the fabric, and not for adding body or weight to the cloth, as is the case with double cloth.

771. Double cloths are dealt with in the next lesson, and the student should be careful not to confound the term extra warp or extra filling, as applied to cloths figured by this system, and the term extra warp or extra filling, as applied to ply or double cloths.

772. The method of producing spots or figures on the face of the cloth, when using only one system of warp and filling, will be dealt with first in this lesson.

773. The first point which must be decided when dealing with spot weaves, is the arrangement of the spots on the cloth, that is, the order in which they will appear; thus, spots may be said to be arranged in *plain* order, *satin* order, *broken crow* order, and many others.

774. By these terms it is meant that the spots appear on the surface of the cloth in the same order that a single end would if the weave being used was a plain, satin, broken crow, and so forth. Thus, it will be seen that in this sense of the word, each spot occupying a different relative position on the face of the cloth may be considered as a single end of a weave.

775. Thus, for an example, suppose that each spot in a spot weave occupies six ends and six picks, and that the spot is to be arranged in plain order. Then on the first six ends and picks of the weave the spot would appear, on the next six ends and picks there would simply be the regular cloth, while on the next six ends and picks the spot would again show, and since this is exactly the manner in which an end interlaces in the plain weave, the spot is said to be arranged in plain order.

776. An example of marking out a spot weave on design paper will be given here, and each step will be thoroughly explained, and by carefully following these explanations, together with the illustrations, the student will no doubt obtain a better idea of this class of weaves.

777. It will be assumed that it is desired to produce a spot weave on eight ends and eight picks, the spot to be arranged in plain order.

778. Since the spot is to be arranged in plain order, there will be two spots in each repeat of the weave, and the eight ends and picks on which the whole weave is to be complete, must first be divided into four squares, each square containing 16 blank spaces of the design paper.

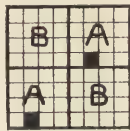


Fig. 173.

779. Fig. 173 represents eight ends and eight picks of design paper marked off in this manner. It will be remembered that it has been stated that the spots, when arranged in plain cloth order, appear upon the face of the cloth in a manner similar to the ends in a plain weave.

780. It will be necessary then to place the spots on the design paper so that they will appear in this order. Suppose, for an illustration, that each of the two large squares running vertically in Fig. 173 represents a single end, and that each of the two large squares running horizontally represents a pick. Then if these were considered as being two ends and two picks of a plain weave, the bottom left hand square would be filled in, also the upper right hand square, or the ones marked A, in the figure.

781. The same system is adopted when arranging the spots in plain order, that is, the spot is marked in the large square

in the lower left hand corner, and also in the large square in the upper right hand corner.

782. Before placing the figure on the design paper, it is best to mark one of the small squares in each of the large squares in which the spots are to be placed, these two small squares to have exactly the *same relative position*.

783. Thus, it will be seen that in Fig. 173 two of the small squares of the design paper have been filled in, and it will be further noticed that each of the small squares thus marked are in the same relative position in the large squares marked with the letter A.

784. It next becomes necessary to determine upon the spot which is to be used, but first it should be noted that it is necessary to select a spot for the figure which *will not occupy so many ends and picks that two of the spots will run into each other*.

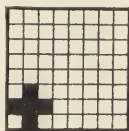


Fig. 174.

785. The entire weave in the example being used as an illustration is to be complete on eight ends and eight picks, and it will readily be seen that the spot figure can not occupy many ends and picks. Fig. 174 shows the spot which will be used in this illustration.

786. It is next necessary to place this spot in each of the large squares, marked A, in Fig. 173.

787. It should be stated that it is not necessary to start the spot weave on any particular end or pick, but it should be distinctly understood that if it is started on a certain end and pick in one of the large squares marked A, it must also be started on the same relative end and pick of the other large square, marked A.

788. This is the object of the filled in squares in the same relative position in each of the large squares in Fig. 173, that is, to give a starting point when placing the spot figure on the design paper.

789. For example, suppose that the lowest square which is filled in, in Fig. 174, is to occupy the square of the weave which is marked in Fig. 173. Then it will readily be seen that if this is done in one of the large squares marked A, it must also be done when placing the spot on the other square, marked A, and by so doing the spots will have the same relative position in the weave and be equally distant from each other.

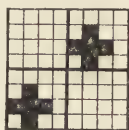


Fig. 175.

790. Thus, it will be seen that by marking certain squares, as was done in Fig. 173, the correct position of the different spots are readily obtained, and it next becomes necessary to place the spots upon the design paper.

791. The method previously spoken of, that is, placing the lowest marked square of Fig. 174 on the squares marked in Fig. 173, will be adopted in placing this spot on the design paper.

792. Fig. 175 shows the spot figure placed upon the design paper in this manner and it will be readily noticed that each spot occupies the same relative position in the large square in which it is placed, and if the student should work out three or four repeats of this figure, in both ends and picks, it would still further be noticed that there is the same distance between the spots in each case.

793. After the spot has been placed upon the design paper, as shown in Fig. 175, it next becomes necessary to fill in the blank spaces with what is known as the ground weave.

794. It will be remembered that the design being used as an example was to be complete on eight ends and eight picks. By noticing Fig. 175, it will readily be seen that if the design was to be complete as shown here, there would be a large number of long floats of filling, and that on the fourth and eighth picks of the weave the filling would even float over the entire warp.

795. This would cause the cloth to be of no value as a fabric, and in order to overcome this defect, the ground weave is added after having placed the spot on the design paper.

796. When selecting a ground weave to be used in a spot figure, the student should always be careful to select one which will match up well with the spot design, that is, one which may be used to good advantage and not allow large floats of warp or filling in any part of the cloth.

797. The most useful weaves for this purpose are the plain, twills and satins, and in determining which to use, each one should be tried until the one which can be used to the best advantage has been determined.

798. It is not always possible to find a weave which may be used, and which will not either run into the spot figure on the one hand, or on the other, leave a larger float in certain places than in others. When this occurs the weave which is the best adapted, should be selected to form the ground.

799. In the example being used as an illustration, it will be assumed that it has been decided to use the plain weave for the ground.

800. In placing the ground weave in a design of this kind, the first square to be marked with a riser should always be carefully selected. Thus, for example, with the illustration being used, suppose that the first riser of the plain weave was marked in the *upper right hand corner* of Fig. 175. It will be readily seen that the next riser would come in contact with a riser in the spot, which should always be avoided if possible,

while on the other hand, if this next square was skipped without being marked, then there would be a float at this point longer than the average float in the rest of the weave.

801. However, by commencing the plain weave in the *upper left hand corner*, and marking this square with a riser, the ground weave will not interfere in any way with the spot. Fig. 176 shows the ground weave inserted in this manner.

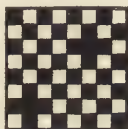


Fig. 176.

802. By referring to this figure the student will readily see that in no place does the plain weave run into the spot, and also that all the floats are of an equal length in the ground.

803. It should be mentioned here that this figure serves as an illustration of the manner of constructing spot weaves, rather than as a good example of such weaves.

804. It will be noticed that this weave is complete on eight ends and eight picks, and since two spots have to be placed in this space, it will readily be seen that it is not possible for the spot to occupy a very large number of ends and picks.

805. In order to have a spot weave appear well in the cloth, it is necessary for the spot figure to occupy a comparatively large number of ends and picks, and consequently most spot weaves will be found to extend for some distance before repeating.

806. It will be remembered that at the first part of this lesson, it was stated that the manner of arranging the spots in the cloth varied; plain, satin and broken crow being some of the orders most commonly met with. An example of arranging spots in plain order has already been given, and an illustration of spots arranged in satin order will next be given.

807. For an illustration, it will be assumed that it is desired to construct a spot weave on 25 ends and 25 picks and that the spots are to be arranged in 5 end satin order.

808. This, as will readily be seen, will necessitate five spots being placed in one repeat of the weave, and therefore the design paper containing the squares on which the complete weave is to be placed will first have to be divided by four lines each way, thus producing 25 large squares. Fig. 177 shows the design paper ruled off in this manner by dotted lines.

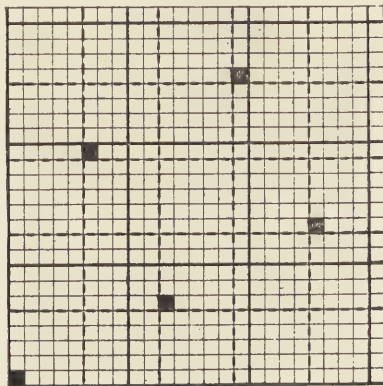


Fig. 177.

809. It will also be noticed, that in this figure a small square has been marked in certain of the larger squares, and it will further be noticed that if a spot figure was to be placed in each of the large squares containing one of these smaller marked squares, the spot would be arranged in the satin order 1, 3, 5, 2, 4.

810. The next thing to be considered is the spot which will be placed on the design. As previously stated, one must be selected which will not be so large that the marked squares of one spot will run into the marked squares of another. In this connection the following illustration will be found by the student to be of advantage.

811. As was stated, the full design is to be complete on 25 ends and 25 picks. Therefore, the number of small squares occupied by this weave on the design paper will be 25×25 , or 625.

812. Since there are to be five spots or figures in this space, then each spot can occupy $625 \div 5$, or 125 small squares. To find how many squares there would be on the side of a large square containing 125 squares, obtain the square root of 125.

813. The square root of 125 is about 11. Therefore, each spot could occupy 11 by 11, but in this case there would be no room for the ground weave, and consequently a spot weave should be selected which is slightly smaller than this.

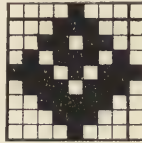


Fig. 178.

814. It will be assumed that the spot shown in Fig. 178 is to be used in this weave.

815. It next becomes necessary to place this spot figure on the design paper in such a manner that it will be arranged in satin order, and have the spots equally distant from each other.

816. In Fig. 177 a small square in certain of the large squares was marked, and by taking these marked squares as a centre or guide, around which to build the spot figure shown in Fig. 178, the desired result will be obtained.

817. It will be assumed that the blank square in the upper part of the spot figure, in Fig. 178, will in each case come on the squares marked in Fig. 177. Then the design as shown in Fig. 179, will be the result.

818. In this figure it will be seen that each square which contains a cross instead of being filled in, comes in the same squares that were marked in Fig. 177. These crosses do not mean warp lifted, but simply show the squares, around which the spots are built.

819. It next becomes necessary to fill in the design with the ground weave, but as the method of doing this has been fully explained in connection with the spot figure arranged in plain order, it will not be necessary to go into details here.

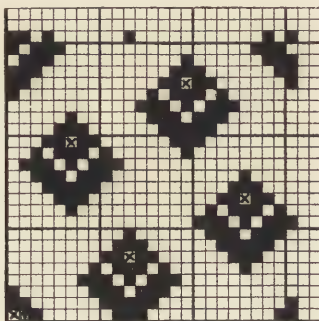


Fig. 179.

Any weave which is complete on 5 ends and 5 picks, and which matches up well with the spot figure without producing any long floats, will be suitable, the five end filling satin probably being as good as any.

820. One more example of a spot weave will be given, and for the purpose of illustration, it will be assumed that it is desired to construct a spot weave on 24 by 24, the spots to be arranged in broken crow order, which will give four spots in each repeat of the weave.

821. Fig. 180 shows the design paper divided into large squares after the manner previously explained. Small squares are also marked, around which the spot figure is to be built.

822. Fig. 181 shows the spot which it is required to place in the weave, while Fig. 182 shows the spots arranged in the manner desired, or broken crow order.

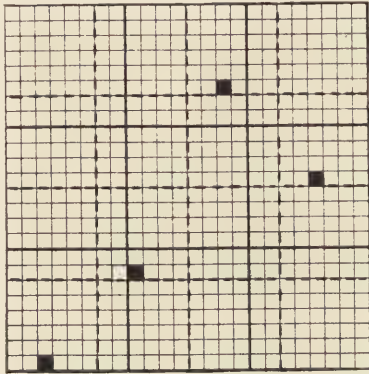


Fig. 180.

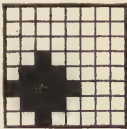


Fig. 181.

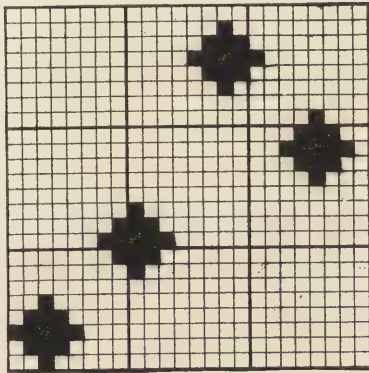


Fig. 182.

823. As will be noticed, the ground weave is not shown in this figure, simply the arrangement of the spots being given.

EXAMPLES FOR PRACTICE.

824. 1. Place the spot shown in Fig. 174 on 24 ends and picks, and arrange it in 8 end satin order.

2. Place the spot shown in Fig. 178 on 18 ends and picks, arranging the spot in plain order. Complete the design by adding the ground weave.

3. Arrange the spot shown in Fig. 181 in 5 end satin order, having the weave complete on 25 ends and 25 picks. Place the ground weave on the design.

4. Complete the design shown in Fig. 182, by inserting a suitable ground weave.

5. Complete the design shown in Fig. 179, by inserting a suitable ground weave.

825. As was stated in the first part of this lesson, spots may be formed on the face of the cloth either by the *same* warp or filling which forms the ground weave, or by the use of a warp or filling *simply for the purpose of forming the spot figure and which is not used at all in the weaving of the rest of the fabric.*

826. All of the illustrations of spot weaves, so far given, have been those which were formed by one warp and filling as will be readily understood.

827. However, in many cases the student will meet with cloths, which have either warp or filling floating for a considerable distance at the back, and brought to the face of the cloth at regular intervals, for the purpose of figuring.

828. This is known as *figuring with extra warp or extra filling*, and the designs are known as **extra warp** or **extra filling** designs, according to whether the figures on the face of the cloth are produced by warp or filling. Extra warp designs will be dealt with first in this lesson.

829. As previously explained, the term extra warp, as its name implies, simply means that the cloth is woven with

two systems of warp yarns. In the first place there is the regular warp yarn, which together with the filling forms the cloth, and secondly, in addition to the regular warp there is also another system of warp yarn.

830. This additional system of warp yarn, or, as it is known, extra warp, is simply for the purpose of figuring the face of the cloth, and when not being used for this purpose floats at the back of the cloth, not appearing at all on the face, and not adding any to the texture of the fabric.

831. In order to fully understand the method of figuring with extra warp, the student should constantly bear this point in mind, namely, that the extra system of warp yarns serves no purpose whatever other than that of figuring the cloth.

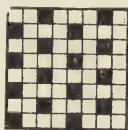


Fig. 183.

832. On this account, the extra warp will be found to very frequently consist of yarns which are either different counts or different color than the regular warp, and moreover, since their interlacings with the filling are at much less frequent intervals, and consequently take up much less in weaving than the regular warp, they are generally placed on a separate beam.

833. When dealing with any cloth which contains an extra warp, there is one characteristic of these weaves which the student should thoroughly understand in order to obtain a good knowledge of the manner in which the effect is formed on the face of the cloth by the extra warp when desired, and yet allowing it to float at the back of the cloth, without appearing on the face, when it is not being used for figuring.

834. Fig. 183 will serve to illustrate this point to the student. This figure shows a supposed eight harness extra warp

weave. (The student should understand that the weave shown in Fig. 183 is only for the purpose of an illustration, since it is of no practical value.)

835. The first, third, fifth and seventh ends, as will be readily seen, are the simple plain weave one up and one down, while the second, fourth, sixth and eighth ends are not marked at all, showing that in every case the filling floats over them. In this illustration the ends which are working plain will be considered as the regular warp ends, while the ends which are not marked will be considered the extra warp.

836. When marking the regular weave, the extra warp ends are not considered at all. Thus in this case it will be seen that, considering only the first, third, fifth and seventh ends, every other one of these ends work alike. This, as will be remembered, is true also of the plain weave.

837. *Thus, this weave may be considered as simply a plain weave opened out by having an extra end placed between each two of its ends.*

838. The point which it is desired to bring out here, is that cloth woven with this weave would be plain cloth with a number of loose ends floating at its back. That is, on the face of the cloth, the extra warp ends would not appear at all, simply the ends forming the plain weave showing.

839. The reason for this may be said to be due to the fact that during the process of weaving, the ends which interlace with the filling are brought together so strongly by the interlacing of each pick that they tend to cover any end which may be down on that pick, and when an end remains down for several picks, while the ends on both sides are interlacing with the filling, it will be entirely covered by the others.

840. Thus, in the case of Fig. 183, the first, third, fifth and seventh ends, being crowded together by the interlacing of the filling, will completely hide the second, fourth, sixth and eighth

ends which are down on every pick, and will accordingly produce the plain weave on the face of the cloth.

841. Continuing still further with this illustration, suppose that the ends working plain in Fig. 183 should continue to interlace in this manner, but that the extra warp ends, instead of being *down* on each pick should be *brought to the face* of the cloth on each pick. The effect in this case would be entirely different. Fig. 184 shows the weave which would produce this result.

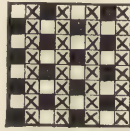


Fig. 184.

842. By comparing Fig. 183 with Fig. 184, the student will readily notice that the *odd numbered ends of each weave are exactly alike*, that is, they are working plain in each figure. These, as will be remembered, are the ends of the regular warp.

843. Again it will be noticed that while in Fig. 183 the even numbered ends are *down* on each pick, in Fig. 184 they are *raised* on each pick.

844. It should be understood that raising these extra ends in this manner does not in any way interfere with those ends which work plain, since they form a plain cloth exactly as in Fig. 183, but in this case the extra warp ends instead of being at the *back* of the cloth are brought to the *face*, with the result that while in the former case they were *covered by the plain weave*, in this case the *plain weave is covered by them*.

845. Thus, with a supposed piece of cloth, woven with the weave shown in Fig. 184, there would be a cloth consisting of a plain weave, which would be covered by loose ends floating on its face.

846. This is the principle on which cloths are figured with extra warp, that is, when the extra warp ends are not required they are covered by the regular weave of the cloth, as shown in Fig. 183, and again when it is desired to produce a spot or figure on the cloth by means of these extra ends they are brought to the face and cover the regular weave of the cloth as shown in connection with Fig. 184.

847. By combining Fig. 183 and Fig. 184, the student will no doubt clearly understand the principle involved.

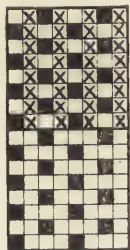


Fig. 185.

848. Fig. 185 shows these two weaves combined, and by considering this figure, together with the explanations which have previously been given, it will readily be seen that on the first or lower eight picks the plain weave alone shows, while on the next eight picks the extra warp ends will cover the plain weave.

849. As previously stated, the figures so far given for extra warp weaves serve merely for illustrations, as they would be of no practical value.

850. Another point which should be noted in connection with extra warp designs, is that the ground weave should always match correctly. Thus, for example, suppose that in Fig. 185, the design stopped with the sixth end, that is to say, the design consisted of the first six ends, as shown in Fig. 183.

851. Remembering what has previously been said in regard to the ends of the ground weave interlacing as though there

were no extra warp ends, it will be readily seen that with a design consisting of the first six ends of Fig. 183, the first and fifth ends of the weave would come together to form the ground weave. But the first and fifth ends are alike and would consequently make as bad a defect in the cloth as would two adjacent ends working alike in a simple plain weave. *In all extra warp designs, the ground weave should always repeat.*

852. It is not necessary that the ground weave of an extra warp design should be the plain weave, as many other weaves are frequently used, for instance, a regular twill will often be found to serve as the ground weave of one of these designs.

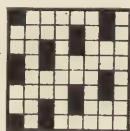


Fig. 186.

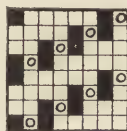


Fig. 187.

853. When making an extra warp design with a regular twill weave for the ground, it is simply necessary to follow the instructions previously given, that is, mark the regular twill on the design, *omitting the ends which are for the extra warp*, then after the ground weave has been marked, next raise the extra warp ends as desired, also see that the ground weave repeats correctly.

854. Fig. 186 shows the manner in which the ground weave would be placed on the design paper considering that every other end was an extra warp end. It will readily be seen by referring to this figure that the ground weave is the regular twill $\frac{2}{2}$, and that it is run up in regular order, ignoring the extra warp ends, two repeats of the picks being shown in this figure.

855. It will be remembered that when first speaking of extra warp designs, it was mentioned that when the extra ends

were not brought to the surface of the cloth to form the figure, they were allowed to float loosely at the back, but in many cases the distance between the places at which these ends are brought to the face is so great that it becomes necessary to fasten them to the cloth by some means. This is known as *tying*, and is a point which should be carefully considered.

856. When tying extra warp ends to the cloth, the principal object is to accomplish this in such a manner *that these extra ends will not show on the face of the cloth.*

857. The manner of doing this is to raise the extra warp end on a pick on which the *ends on each side of it are also raised.*

858. Fig. 187 will serve to make this somewhat plainer. This figure shows a portion of an extra warp weave, in which the extra warp ends are tied to the cloth in such a manner that they will not show on the face. The filled in squares show the ground weave, while the circles show the extra warp ends raised for the purpose of tying.

859. By referring to this figure it will be seen that in each case where the extra warp ends are raised, the ends of the ground weave, *on each side*, are also raised, thus, on the first pick it will be seen that the second end of the weave is raised. This is the first extra warp end, but it will also be noticed that the first and third ends are raised on this same pick, these two ends being the ground weave.

860. By this means the extra warp end is *covered* by the ground ends and does not show on the face of the cloth, although it is raised over the pick of filling.

861. On the other hand if this extra warp end was raised on the third pick, it will be seen that there would be no ground ends to cover it, and it would consequently show on the face of the cloth.

862. Therefore, in tying any extra warp ends to the cloth care should always be taken to have the *ground ends on both sides raised at the same time.*

863. It should be understood by the student that an extra warp end does not come between each end of the ground, except in that part of the warp where the figure is to be produced.

864. Thus, for example, there may be any number of ends or picks that may be desired between each figure which is produced on the cloth by the extra warp ends. The figures which have thus far been given show only that part of the design which contains the extra warp ends.

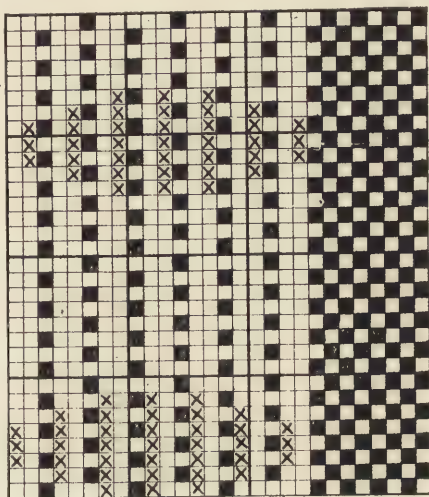


Fig. 188.

865. Fig. 188 shows an extra warp design complete. It will be noticed that in this figure there are two ends of the extra warp between each two ends of the first part of the ground weave, and it will also be noticed that where one set of these extra warp ends is raised, the other set remains down. Thus by using different colors of yarns two spots of different colors will be formed on the face of the fabric.

866. As will be seen, the ground weave consists of the ordinary plain weave, and it will also be noticed that the last eight ends of the weave consist only of the ground weave, that

is, with this design there will be eight ends of ground between the last end of one spot and the first end of the next one. By repeating these last eight ends a number of times, a larger amount of ground could easily be placed between the spots.

867. Thus, for example, suppose that the last eight ends, as shown in Fig. 188, were marked ten times. This would mean that instead of there being eight ends of plain at this point, there would be ten times eight, or eighty ends. This would naturally increase the distance between the spots across the cloth. The distance between the spots lengthway of the cloth may also be increased by increasing the number of picks between the spots.

868. In making out the drawing in draft for an extra warp design, there is one point that should be carefully noted, which is that the extra warp ends and the ground ends are drawn in on separate sets of harnesses.

869. The extra warp ends in these designs are always much less in number than the ground ends, and consequently it is a good plan to place these on the back harnesses, since being fewer in number there will naturally not be as many of them break during weaving.

870. When the ground ends are placed on the front harnesses, it is much easier for the weaver to piece them when they break. It is also much easier for the person drawing in the warp to draw the largest number of ends through the front harnesses.

871. A drawing in draft will be shown for Fig. 188 adopting this principle, that is, placing the extra warp ends on the back harnesses and the ground ends on the front harnesses.

872. As was stated previously, the ground ends of this weave work plain, therefore, they could be drawn in on two harnesses, but in order to prevent over crowding of the ends, they will be placed on the *four front* harnesses.

873. Next considering the extra warp ends, it will be seen that the first, second, fourth, fifth, seventh and eighth ends of the design all work differently, therefore, they must be placed on different harnesses. This will necessitate at least six harnesses for the extra warp.

874. It will also be seen that this part of the weave could be made on this number of harnesses, since the tenth and thirteenth ends are like the seventh; the eleventh and fourteenth like the eighth; the sixteenth like the fourth; the seventeenth like the fifth; the nineteenth like the first and the twentieth like the second. Therefore, the whole weave will be drawn in on ten harnesses.

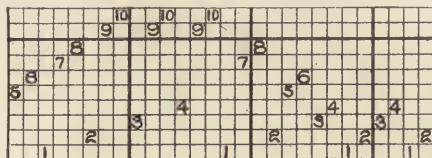


Fig. 189.

875. Fig. 189 shows the drawing-in draft for Fig. 188, and by comparing these two figures, the principle adopted will be readily seen.

876. It was previously stated that the ground ends were to be drawn through the first four harnesses, and the extra warp ends were to be drawn through the last six harnesses, or the fifth, sixth, seventh, eighth, ninth and tenth.

877. Commencing then with the first end of the weave, as shown in Fig. 188, it will be seen that this is the first end of the extra warp ends, therefore, this would be drawn through the fifth harness, the second end of Fig. 188 is the second of the extra warp ends, therefore, this would be drawn through the sixth harness.

878. The next, or third end of the weave, is the first end of the plain, therefore this is drawn through the first harness.

The next end of the weave is the third end of the extra warp, and since it is working differently than any of the others which have been dealt with so far, it is drawn through the seventh harness.

879. This is continued throughout the 28 ends of the weave, shown in Fig. 188, each end being drawn through its respective harness, as shown in Fig. 189.

880. **Extra filling** designs are the reverse of extra warp designs, that is, in this case the spot, or figure, is formed on the face of the cloth by means of *allowing certain picks of filling to float over the warp ends at certain points.*

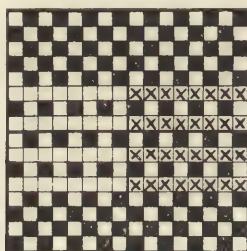


Fig. 190.

881. Fig. 190 will serve to illustrate the method of making an extra filling design. By referring to this figure it will be seen that the ground weave consists of the simple plain weave.

882. On the fifth, seventh, ninth and eleventh picks the extra picks of filling are inserted. In order to allow the filling to float on the face of the cloth it will be necessary to lower the ends on those picks. Thus, it will be seen by referring to Fig. 190 that the first eight ends are lowered on the fifth, seventh, ninth and eleventh picks, consequently the extra filling will float on the surface of these eight ends. The same result will be obtained as was explained in connection with the extra warp floating over the picks, that is, in this case the fifth, seventh, ninth and eleventh picks floating over the first

eight ends will completely hide the interlacings of the sixth, eighth and tenth picks, thus causing a spot to appear on the face of the cloth at this point.

883. On the other hand where it is desired that the extra filling shall not show, it is necessary to raise all the warp ends on the picks on which the extra filling is inserted. Thus, in the case of Fig. 190, it will be seen that the last eight ends are all raised on the fifth, seventh, ninth and eleventh picks, consequently the extra filling will not show in this portion of the weave, but will float at the back, and the interlacings of the fourth, sixth, eighth, tenth and twelfth picks of filling will cover the extra filling picks in the same manner as was explained when dealing with extra warp.

884. In order that the student may better understand the construction of these weaves, an extra filling design will be worked out here, each step being shown, and in this connection it would also be well to bear in mind that all the remarks made here, in regard to extra filling designs, apply equally well to extra warp designs, the only difference being that in one case the figuring is done with extra filling, while in the other it is done with extra warp.

885. For the purpose of illustration, it will be assumed that it is desired to take the spot weave shown in Fig. 178, and from this form a spot design, using extra filling for the purpose of forming the spot on the face of the cloth, and also arranging the spot in plain cloth order. It will also be assumed that every other pick is to be a pick of extra filling.

886. For a person just learning to make these designs, the best plan is to mark on the design paper exactly what each pick is to be, that is, if the first pick is to be a pick of the ground filling, then mark this in some manner so that it can readily be distinguished from the extra filling picks; then, if the next pick is to be an extra filling pick, mark this in order that it may be distinguished from the ground.

887. It will be remembered that it was stated that the ground and extra filling picks were to be arranged one and one, and since the spot design occupies nine picks and is to be arranged in the plain cloth order, then two spots must be shown which together will occupy 18 picks. These 18 picks which show the spot design will be the extra filling picks, and it will be assumed that the ground picks will consist of the regular twill, 3 up and 3 down.

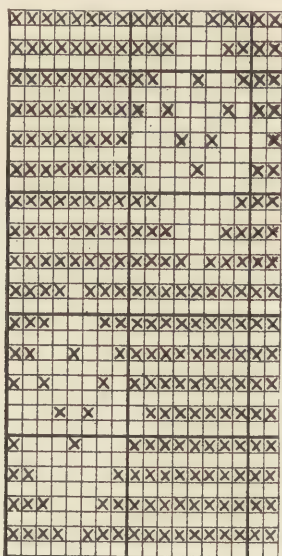


Fig. 191.

888. One point which should be carefully noted here is that since the spot design occupies 18 picks and the complete design is to be arranged one of ground and one of extra filling, then the complete design will occupy twice the number of picks which the spot figure occupies, or 36 picks. But the weave will be complete in its ends on 18, therefore the complete weave will occupy 18 ends and 36 picks.

889. Another point which should be carefully noted is that since the spot figure is to be shown by means of the *filling*

floating over the warp ends, then, wherever it is desired to have the spot show, it is necessary to have the warp ends down at that point, but where it is not desired to have the spot show, then all the warp ends must be lifted at that point, in order to keep the extra filling from showing on the face.

890. Fig. 191 shows the weave constructed up to this point, that is, with the spot figure arranged on extra filling picks. It will be seen by referring to this figure that the ground picks have not been marked and consequently the two systems of picks can readily be distinguished one from the other. It will also be noticed that wherever it is desired to have the extra filling float on the face of the cloth in order to form the spot, the warp ends are lowered at those points, and on the other hand, wherever it is desired that the extra filling shall not show on the face of the cloth, then all the warp ends are raised at that point.

891. By referring to Fig. 191, and considering only the extra filling picks, not taking into consideration at all the ground picks, it will be seen that where the *warp ends are lowered on these picks* the filling will form a spot design which is exactly similar to that shown in Fig. 178. It should be borne in mind that where the extra filling floats on the face of the cloth, it will at those points cover the ground picks which float at the same point, in the same manner as the extra warp ends cover the ground ends in extra warp designs.

892. After constructing the weave up to the point shown in Fig. 191, it next becomes necessary to fill in the ground picks with the ground weave. As has been stated previously, the ground weave for this design is to be the regular $\frac{2}{3}$ twill, and it simply becomes necessary to place this twill on the ground picks, running it up in regular order, and not considering the extra filling picks; that is, the 3 up and 3 down twill will appear as it would on the 18 ends and 18 picks if opened out, and a blank pick placed between each of the picks of the twill.

893. Fig. 192 shows the completed weave, and by referring to this figure, the student will understand the method of placing the ground weave on the ground picks. In this figure the crosses show the warp ends raised on the extra filling picks, while the filled in squares show the ground weave placed on



Fig. 192.

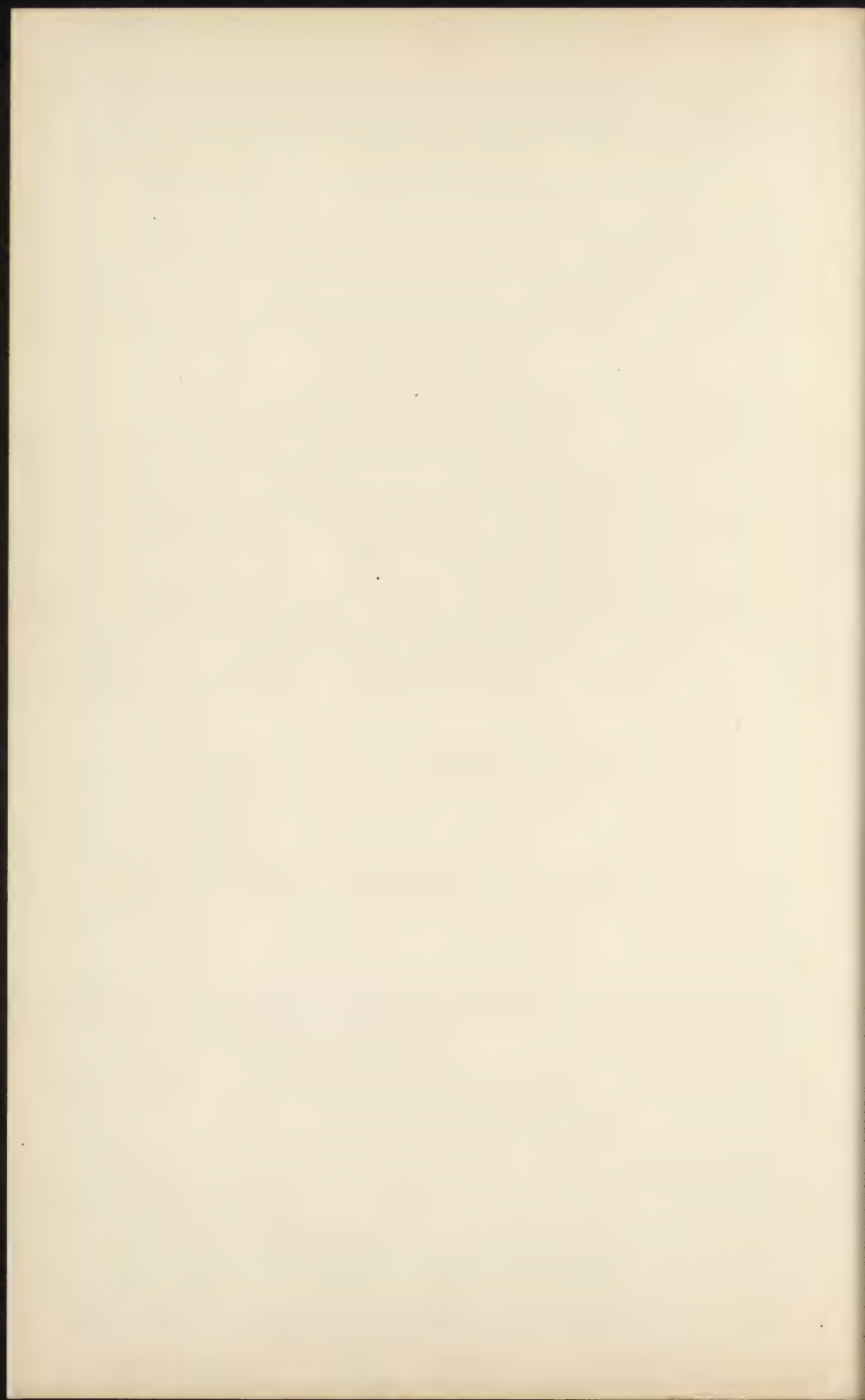
the ground picks. Extra filling is tied to the body of the cloth after the manner explained when dealing with extra warp, except that in this case the pick of extra filling when tied, must be raised *between two floats of the ground filling*.

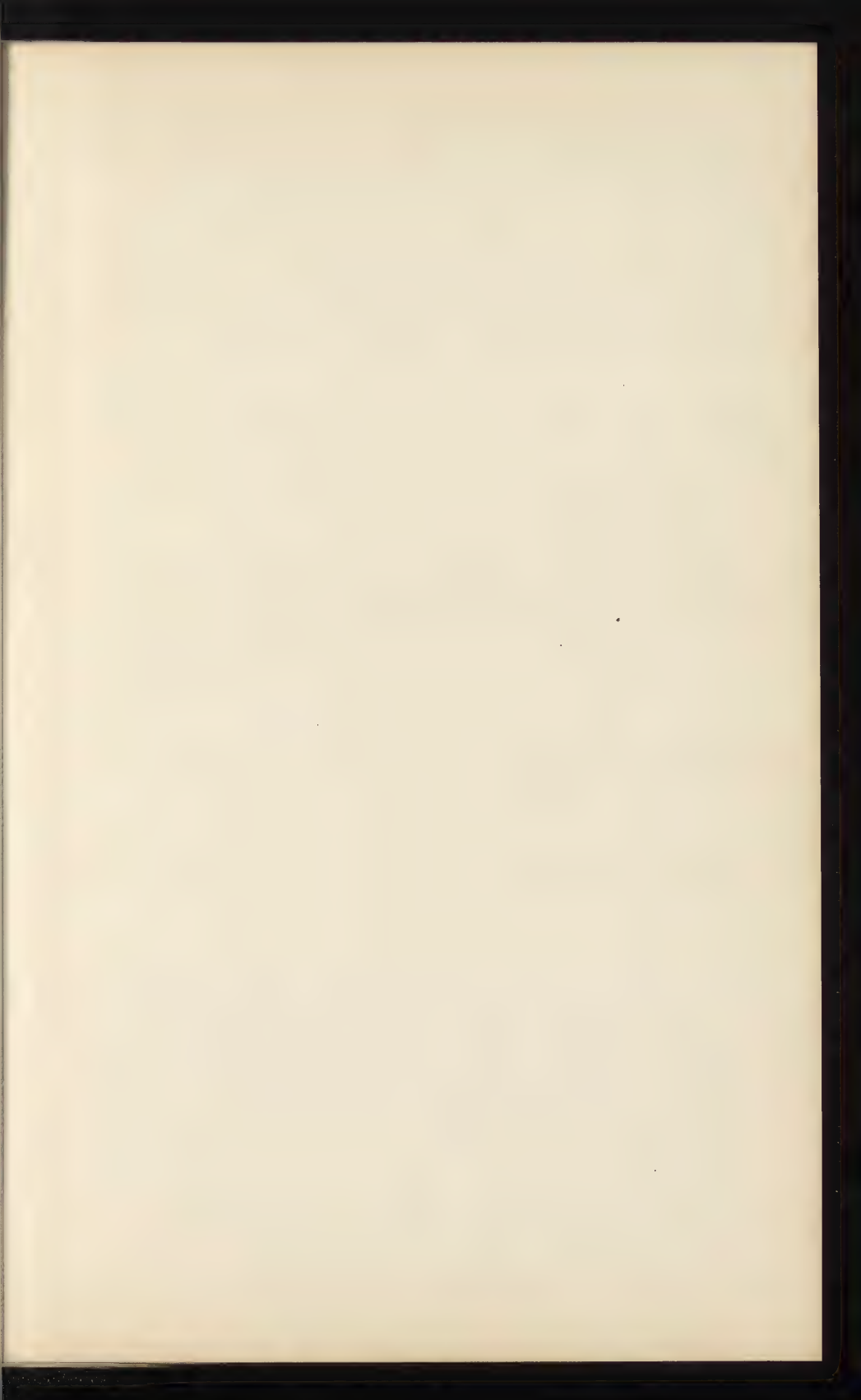
The student should understand that when weaving extra filling designs with more than one kind of filling, a loom which has more than one box on each side must be used.

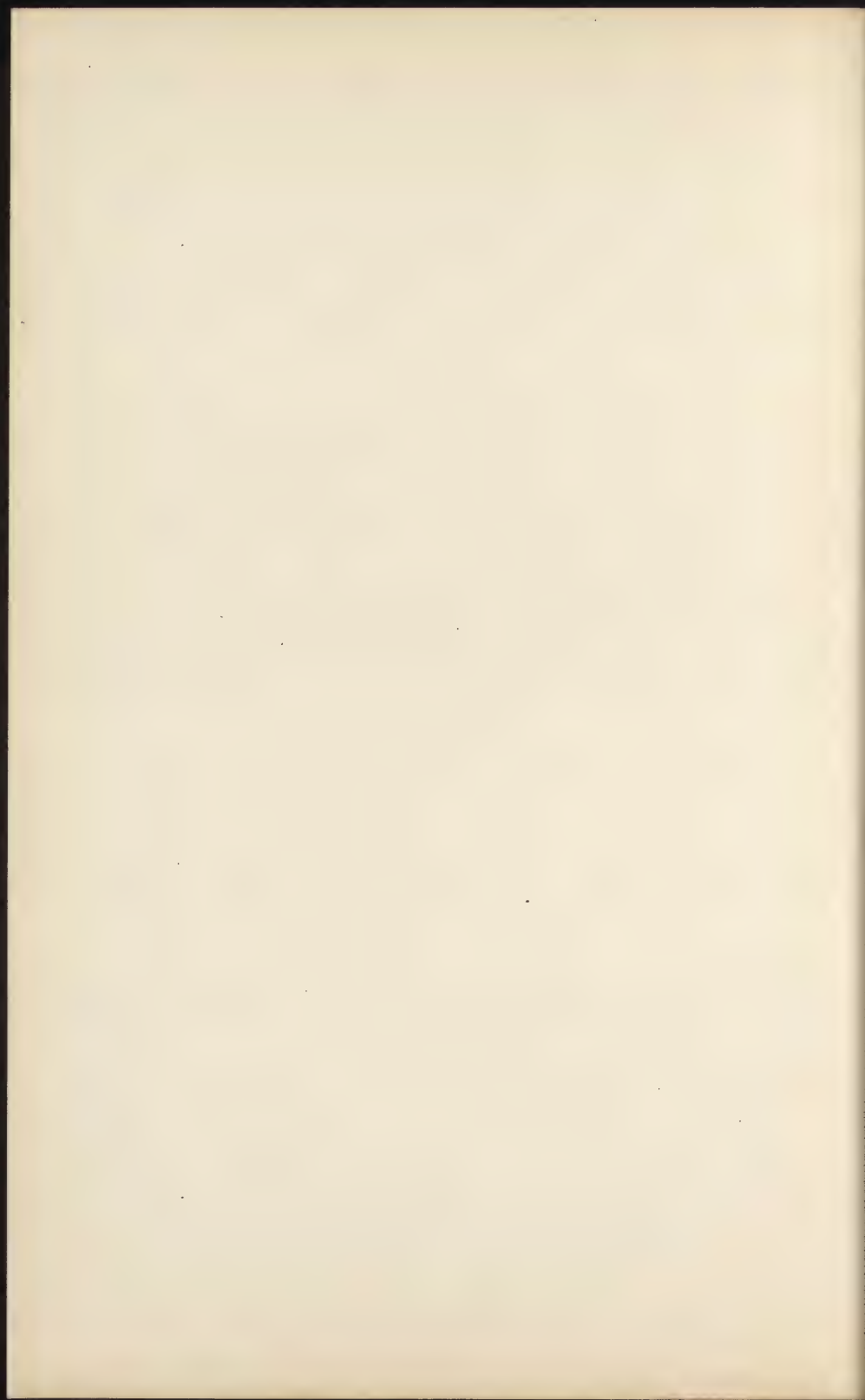
This will be dealt with more fully in the next lesson when explaining backed cloths.

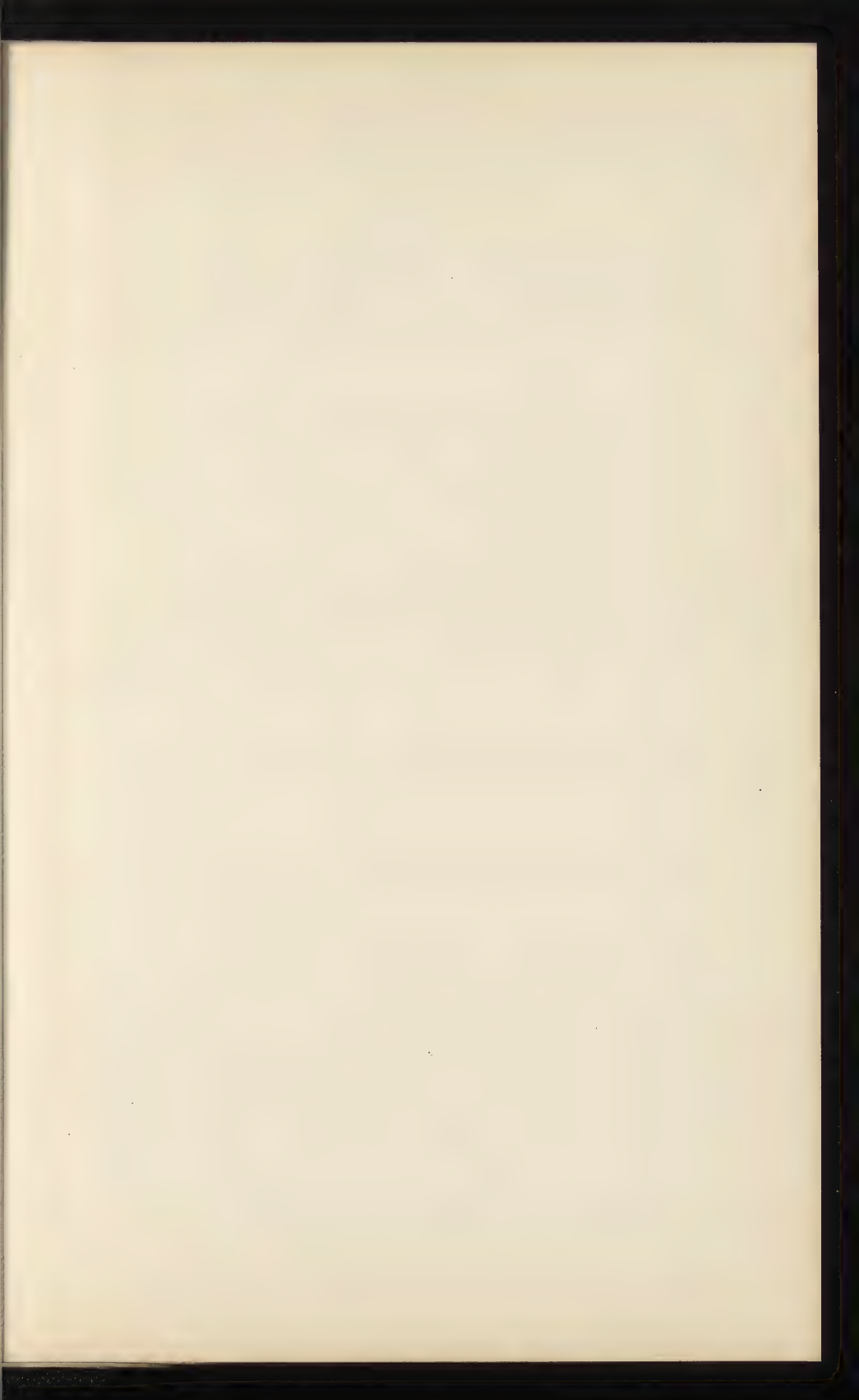
894. In connection with this design one point which should be noticed is that the weave as shown on the design paper

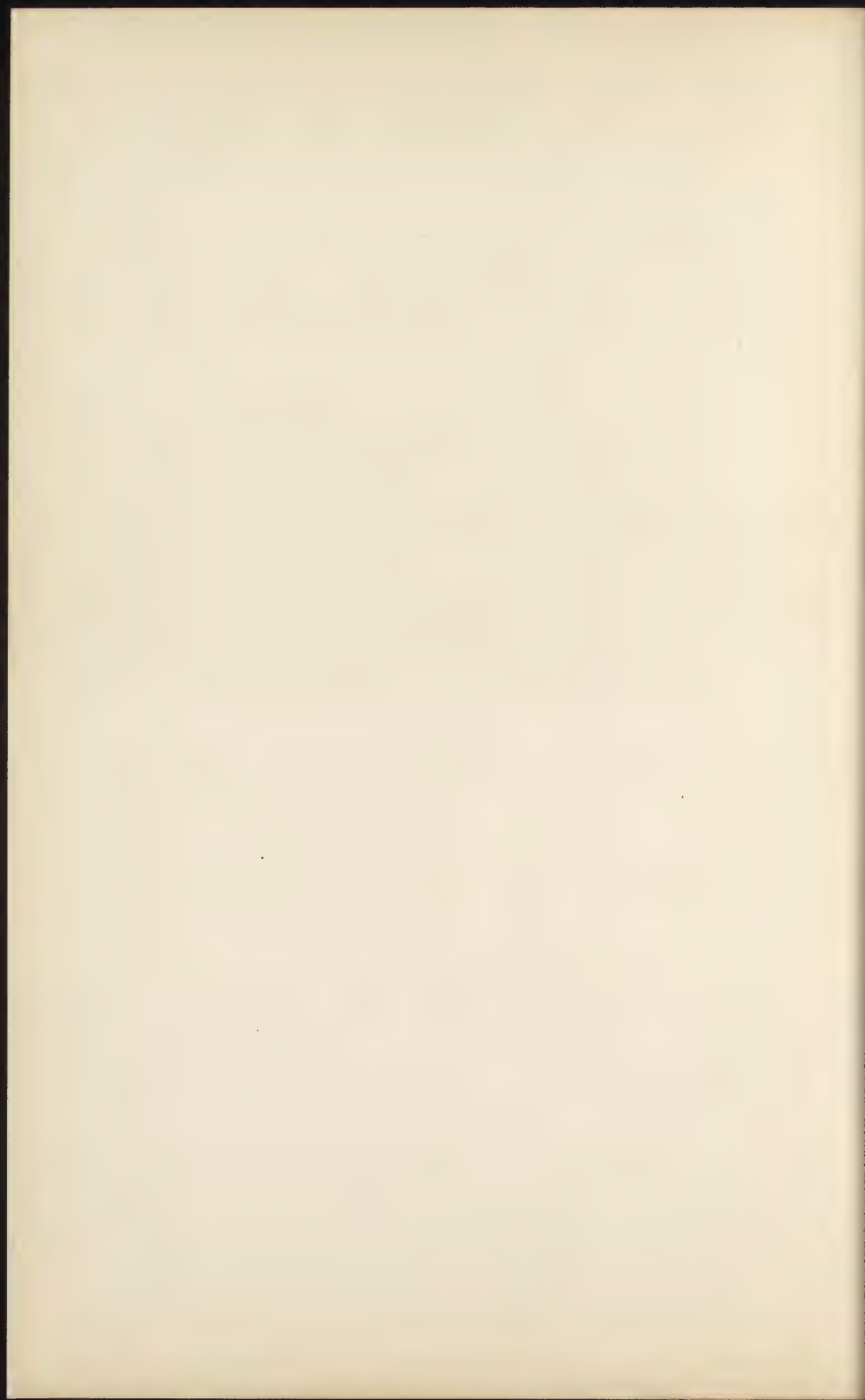
occupies 18 ends and 36 picks. When, however, this is woven, the design in the cloth will be square, occupying a space in width equal to 18 ends, and although in length there will be 36 picks before the design repeats in its picks, yet the space occupied by these 36 picks will be the same as that occupied by the 18 ends, the reason for this being that the ground picks crowd over the extra filling picks, and since the design is arranged, one of ground and one of extra filling, then it will occupy a space equal to one half the number of picks upon which it is complete.











BACKED COTTON FABRICS.

895. The previous lesson, Part VI. of Designing, dealt to a large extent with cloths figured with extra warp and extra filling, the extra systems of warp or filling in these cases being adopted simply for the purpose of producing a figure on the face of the cloth.

896. However, there are other cases in which an extra system of warp or filling is adopted for the purpose of adding weight, or warmth to the cloth, in which case the extra yarns are stitched to the cloth at regular intervals in such a manner that they do not show on the face of the cloth at all.

897. Cloths of this description are known as **backed** fabrics, and under this head are found two sub-divisions, namely, cloths *backed with warp*, and cloths *backed with filling*.

898. The manufacture of backed cloths is often resorted to for the purpose of making a heavy and yet cheap fabric, this being readily accomplished by using cheaper yarn for that portion of the fabric which remains at the back.

899. It will be seen that by using a cheaper extra warp or filling, a thicker and more substantial cloth can be obtained at a low cost. The thickness and weight may also be obtained without altering the fineness of the face of the fabric or without changing its appearance.

900. **Filling backed** fabrics will be dealt with first in this lesson, as it is a little easier to understand this class of backed fabrics, since the drafting of the weaves is a little less difficult than is the case with warped backed fabrics.

901. A filling backed fabric may be considered to be a single cloth, consisting of one warp and one filling, but having stitched or tied to the back an extra set of filling threads, which are interlaced with the face cloth just enough to keep them attached, and prevent the floats upon the back of the cloth from being so long that they will be loose.

902. This effect is obtained by raising the warp yarn in such a manner that when the face, or regular filling is inserted, it will interlace with the warp and form the pattern desired. When, however, the pick of backing filling is placed in the cloth, *all of the warp ends are raised, with the exception of a certain few which are left down in order to bind or stitch the backing filling to the face cloth.*

903. This has the effect of making the picks of backing filling float on the back of the cloth, with the exception of the few ends over which it passes in order to accomplish the stitching.

904. In regard to the ends which are depressed to tie the backing filling to the face, there is one important point which the student should always bear in mind, and that is to so arrange the tying places that the backing filling will *float over the face warp thread between two floats of the face filling.*

905. The object of this is to cover the tying places so that they cannot be seen on the face of the cloth.

If the cloth is tied as mentioned above, this is easily accomplished, since the two floats of the face filling, one upon each side of the backing float, will crowd over the backing pick and thus hide it from view.

906. In Part VI. of Designing, mention was made of the manner in which the extra warp, or the extra filling should be tied to the ground warp when the floats of these extra threads, at the back, were too long. The same principle is adopted when stitching the backing filling to the face cloth.

907. Filling backed fabrics are made with one pick of face and one of back, and also with two picks of face and two of back. The designs are made in the latter manner when it is desired to weave the cloth in looms which do not have more than one box on both sides of the loom.

908. It should be stated here that, since filling backed fabrics are composed of two different fillings, the employment of a box loom for their production is necessary unless the same yarn is used for the backing filling as for the face, which is not usually the case.

909. As previously stated, fabrics with two picks of face and two of back are necessary, in case the cloth is woven in a loom which has but one box on one of its ends, since in this type of loom it is not possible to put in a single pick of one kind of filling, as the shuttles always have to return to the box side before changing.

910. Fabrics in which a single pick of the backing filling is inserted at a time, require a loom with more than one box at both ends, in which it is possible to change the filling at either side of the loom and consequently on any pick.

911. When, as is often the case, coarser yarns are used for the back than for the face filling, the fabric is often woven with one pick of backing and two picks of face and sometimes, in extreme cases, three or even four face picks are used to one of backing.

912. It was previously stated that the tying places, in filling backed fabrics, should always be placed between two flushes of the face filling, in order to hide the back pick, and it should also be mentioned that these tying places should be *placed uniformly throughout the fabric* in order that the cloth shall not cockle.

913. The best method of distributing the tying places is in satin order, since by this method they are not only evenly

distributed, but all liability of the stitching forming twill lines on the face of the cloth is obviated.

914. Although the method of distributing the tying places in satin order gives the best fabric because of the scattered, yet uniform disposition of the interlacings of the back filling with the face warp, still it often happens that the character of the face weave is such that the tying places can not be distributed in this manner and at the same time bring each tying place between two flushes of the face filling.

915. When such is the case it is always better to adopt some other system of binding rather than to run the risk of having the backing yarn show on the face of the goods.

916. The designer should always distribute the tying places as evenly and uniformly as possible, and if it is found that satin order cannot be used to advantage, then some other, such as twill, broken crow, and so forth, must be adopted.

917. With the class of fabrics under consideration, it is impossible to form any fancy effects on the back of the fabric, and in fact this is not desired, the main object being to produce a heavy or medium weight fabric, yet with a fine face produced with yarns of fairly high counts.

918. When making designs for filling backed fabrics, the first step is to indicate the face and back picks on the design paper, in order that they may not be mistaken and the wrong weave placed on the wrong pick.

919. This may be accomplished by placing a small mark at one side of the design, opposite each backing pick, or preferably by shading the backing picks with a colored pencil, a blue pencil being recommended.

920. When marking the design paper in this manner, if the design is to be composed of one pick of face and one pick of back, it is better to start at the bottom of the design and make the first pick a face pick. The second pick

should be made a back pick by shading, and so on until enough picks to place the design on have been treated in this manner.

921. In order that the student may thoroughly understand the method of backing a weave with filling when designing filling backed cloths, an example will be given here and each step of the process explained.



Fig. 193.

922. Suppose it is desired to back the eight harness twilled basket weave, shown at Fig. 193, with filling in order to obtain a heavier fabric, the filling to be inserted one pick back, two picks face. This will give four picks of back and eight picks of face, or twelve picks altogether in one repeat of the design.

923. When making a filling backed design of any description, care must be taken to *have both the back and face weaves evenly repeated in the back and face picks respectively*. The method of backing must also be considered when considering the size of the completed design.

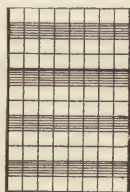


Fig. 194.

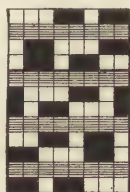


Fig. 195.

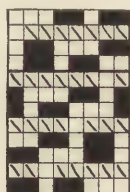
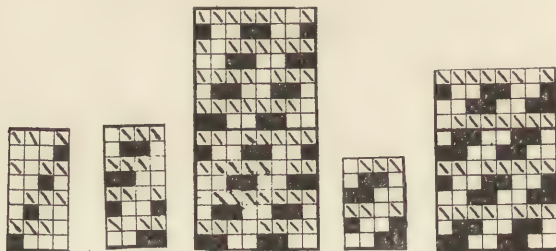


Fig. 196.

924. The first operation is to indicate the backing picks, which, as previously described, may be done by shading them with a blue pencil, as shown at Fig. 194.

925. Next place the face weave, shown at Fig. 193, on the face picks, shown at Fig. 194. The method of doing this is indicated at Fig. 195, where it will be seen that the face design is placed only on the face picks, the backing picks not yet being marked.

926. The next step in the formation of the design is to *raise all the warp on the backing picks*, except such threads as are required to be left down for the purpose of binding the backing filling to the body of the cloth.



Figs. 197, 198, 199, 200, 201.

927. The method of doing this is shown at Fig. 196. By referring to this design it will be noticed that the binding, or tying points, are distributed in twill order, as this is the best method by which this design can be stitched, it being obviously impossible to use satin order of tying without repeating the design, since there are only four picks of backing filling.

928. It will now be noticed that the binding places, where the back filling comes to the face of the cloth, are placed between two floats of the face filling, thus hiding the pick of backing filling.

929. Thus, for example, by referring to Fig. 196, it will be seen that the filling floats of the first and third picks, which are face picks, are raised on the same end that the second pick is, which is a backing pick.

This method of raising the picks of backing filling occurs throughout the weave.

930. It will be noticed that each pick of backing filling in this design is tied to the face only *once* in eight ends, but it would readily be possible, with this design, to bind the backing filling *twice* in eight ends, or once every four ends, if it is desired to produce a firmer piece of goods.

931. At Fig. 197 a filling backed design is shown which is arranged one of face and one of back. In this design every end of the warp serves at one time or another to bind the backing filling to the face.

932. Tying on *every end* of the warp in filling backed fabrics, makes the most perfect cloth, since all of the ends will then take up the same, and there will be no liability of the cloth wrinkling. However, this is not always done, especially when a soft cloth is desired. Very often *every other end* of the warp serves to tie the backing filling, as is the case in Fig. 196.

933. It is not best, however, to tie on every other warp end, if a very thick or coarse backing yarn is to be used, since this will surely make a faulty cloth, unless two warp beams are used, which is rarely done with a filling backed fabric.

934. When designing filling backed cloths it is always best to use soft twisted yarn for the backing. Hard twisted or too coarse backing yarn is more or less liable to show on the face of the cloth, especially if fine yarns are used for the face weave.

935. As the student becomes more familiar with backed designs, it will be found unnecessary in many cases, especially with small designs, to indicate the backing picks, but it is always better to do so, as it is a great help in preventing one from becoming confused.

936. In all the filling backed designs in this lesson the face weave will be shown by the filled in squares, while the oblique marks will show the face warp lifted for the insertion of the backing picks.

937. The cassimere twill $\frac{2}{2}$ is a weave which is often required to be backed with filling, and at Figs. 198, 199, 200 and 201, four standard methods of accomplishing this are shown. The designs at Figs. 198 and 199 are to be preferred, as the backing is tied equally on each end of the warp. Figs. 200 and 201, while not tied perfectly, may be successfully used in cases where the backing filling is not too coarse.

938. In some weaves it will be found impossible to tie the backing filling perfectly between every two face picks. When this is the case it is best to arrange the design so that two picks of face will be put into the cloth in succession before inserting the backing picks.

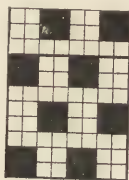


Fig. 202.

Fig. 203.

939. At the same time the best relation of the face weave to the back weave should be considered. For instance, suppose a weave was placed on design paper as shown at Fig. 202. It will readily be seen that in this case there is no place where the backing pick can be raised for stitching without having the face warp up on one side, and as previously explained, the stitching will show on the face of the goods unless covered by face filling floats.

940. If, however, the face weave was placed on the design paper, as shown at Fig. 203, the backing could readily be stitched to the face without any danger of its showing. The backing weave in this design is the broken crow weave.

941. Weaves which have a large percentage of warp on the face, and especially warp flush twills, are the hardest

weaves to back with filling on account of there not being positions in the weave which will cover the tying places perfectly.

942. When such weaves are backed with filling and it is impossible to have a face filling flush on each side of the tying place, the design should be so arranged that the flush of face filling, which is next to the tying place, shall *follow*, instead of precede, the flush of backing filling.

943. When the face flush *precedes* the backing flush, the tie will show prominently on the face of the goods, but when the face flush *follows* the backing flush, the reed, in beating up the filling, will push the face pick over the backing pick.

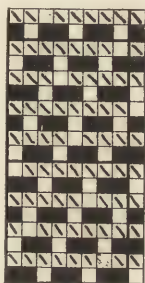


Fig. 204.

944. The method stated above is employed in the weave shown at Fig. 204. The student will notice that in this weave the warp face prunelle twill has been backed with filling, the backing weave being the nine end satin weave.

945. At Fig. 205 a 10 harness regular twill $\frac{5}{5}$ is shown, while at Fig. 206 the same twill is shown backed with filling, being arranged two of face and two of back. The student should notice particularly the arrangement of the tying places in this design as well as those in Fig. 207, which represents two repeats of the same twill backed with filling and arranged two of face and one of back.

946. In Fig. 207 it will be seen that the method of stitching adopted is to tie on every other end by two lines of twills, thus tying on all of the ends in the warp.

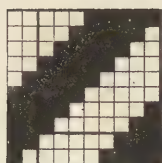


Fig. 205.

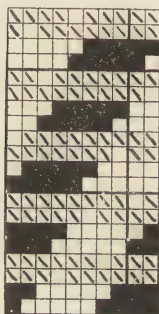


Fig. 206.



Fig. 207.

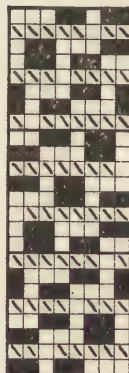


Fig. 208.

947. In order to obtain a good system of tying, it is often necessary to repeat a design. Thus, for instance, if it was desired to use heavy or coarse backing filling in the design shown at Fig. 196, it would be necessary either to bind

the filling once in every four warp ends, or to repeat the design and bind as shown in Fig. 208, which shows Fig. 196 repeated in its picks.

948. When tying a backing filling to a face cloth which has long filling floats, always make the tying places *come as near the centre of these floats as possible*, since when tied in this manner the binding points will be more easily covered.

EXAMPLES FOR PRACTICE.

949. 1. Make a filling backed design, arranged 1 face, 1 back, using the $\frac{4}{4}$ regular twill for the face. Tie the backing filling perfectly, once on each warp end.

2. Make an 8 end filling satin and back it with warp, arranging it 1 of face and 1 of back.

3. Back the cassimere twill with filling, the design to be arranged 1 of face and 1 of back and to be weavable on 4 harnesses.

4. If a 12 harness regular twill is backed with filling, the design being arranged 1 face, 1 back, 1 face, on how many ends and picks will the design be complete?

5. Back the regular twill $\frac{2}{2}\frac{2}{2}\frac{1}{1}$ with filling, arranging the design 1 of face and 1 of back. Tie each backing pick once in 10 warp ends.

6. Back the $\frac{3}{1}$ twill, twilled to the left, with the eight end satin weave, arranging the design 1 of face and 1 of back. Have the face filling flush follow rather than precede the back filling flush.

950. Warp backed cloths will be the next type of fabric which will be dealt with in this lesson. These consist of those cloths constructed with one system of filling, and one system of warp yarns, for forming the face of the goods, and also an extra system of warp yarn for making a heavier and warmer fabric than would be possible with a single cloth.

951. Warp backed cloths require more harnesses than filling backed cloths, because of the extra or backing warp, while on the other hand, they can be woven in looms with single boxes, since there is only one system of filling to be placed in the cloth.

952. This is a great advantage in many cases where single box looms are all that can be had. It should be understood that this applies only to cloths in which one color of filling is used, since if more than one color is used, a box loom will be necessary.

953. Warp backed cloths require only the same amount of time to weave them that would be occupied in weaving any cloth with the same number of picks per inch, since there are no extra picks of backing filling to be placed in them.

954. Color can also be applied to the back of warp backed fabrics to advantage, since stripe effects can be easily made, while with filling backed cloths only bars can be made across the cloth, and this is rarely a satisfactory method of applying color.

955. However, care should be taken in all cases where a color different from that of the face yarn is applied to backed cloths, to have the binding points perfect so that the color of the backing yarn will not show on the face of the goods.

956. In weaving the majority of cloths backed with warp, two beams are required, since the backing warp is generally of a coarser yarn and generally has different interlacings with the filling than does the face warp, thus causing a different amount of contraction.

957. Again, it is necessary that the backing yarn in a warp backed fabric should be harder twisted than the backing yarn in a filling backed fabric, since it has to withstand the strain that comes upon all warp yarn during weaving.

958. It will be readily seen that on this account warp backed fabrics will be harsher and stiffer feeling goods than

filling backed fabrics in which soft twisted yarns are almost exclusively used for the backing filling.

959. There are several important points which should be noted when considering warp backed fabrics.

First. The backing warp has to be raised over a pick in every instance where it is desired to bind the back to the face cloth. This, it will be seen, is the reverse of the case with filling backed fabrics, where a warp end was depressed in order to bind the cloth.

In warp backed fabrics the tying places should always be placed between two warp flushes of the face cloth, in order that the tying may be covered and not show on the face of the cloth. If in any case this is impossible the backing warp should be raised either to the right or left of a face warp flush.

Second. If there are more intersections of the face warp with the filling than there are of the back warp with the filling in a given number of picks, or if one series of warp yarn is coarser than the other, it will be necessary to place the two warps on a separate beam, since the take up of the warps in weaving will be different.

Third. It is always best to select weaves of regular structure, such as satins, broken crow, and so forth, for the backing weave, so that each backing end will have the same number of interlacings.

960. There are other points besides these already mentioned, which it will be well for the student to consider in designing the warp backed class of weaves. For instance, if a design of this class is arranged one of face and one of back, the backing warp should never be of heavier yarn than the face, since if this is the case the back will show through on the face of the cloth.

961. If the design is arranged two of face and one of back, then a proportionately heavier yarn can be used for the back warp.

962. In order that the student may thoroughly understand the method of designing warp backed fabrics, an illustration will be given here and each step in the process worked out separately, finally showing the complete weave.

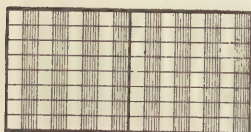


Fig. 209.

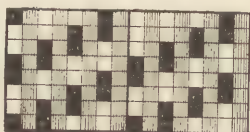


Fig. 210.

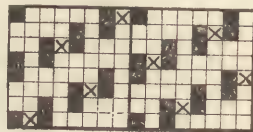


Fig. 211.

963. Suppose, for example, that it is desired to back the cassimere twill with warp, using the 8 harness satin weave on the back of the cloth, the design to be arranged one of face warp and one of back.

964. As the back weave in this case will require 8 ends it will be necessary to show two repeats of the face weave in the complete design, the cloth being backed one and one. Therefore the finished design will be complete on 16 ends and 8 picks.



Fig. 212.

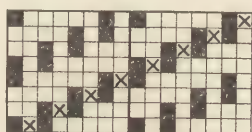


Fig. 213.

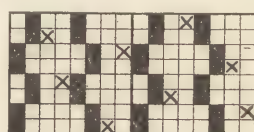


Fig. 214.

965. The first operation is to shade, or in some manner indicate the backing ends in order that they may be distinguished from the face ends. The method of doing this is shown at Fig. 209, where it will be seen that the design paper is prepared for marking the face weave.

966. Fig. 210 shows the cassimere weave, which is to be used for the face weave in this design, placed on the face ends of the weave.

967. The next step is to place the backing weave on the design. It will be remembered that the back weave is to be the eight end satin, and as the back weave must flush on the back of the cloth, each back warp end should be raised only once in eight picks and in satin order.

968. The method of placing the back weave upon the design paper is shown at Fig. 211, where the design is shown complete. In this figure the method of raising the back warp at the tying places, between two face warp flushes, should be carefully noted, the object of course being to allow the floats of face warp to crowd over and hide the tie.

969. In order that the student may thoroughly understand warp backed designs, a few illustrations will be given, showing the methods of backing different weaves with warp.

970. In all the warp backed designs given in this lesson, the face weave will be indicated by the filled in squares, while the back warp raised to the face will be indicated by crosses.

971. Fig. 212 shows the cassimere twill backed with warp. In this case, however, the design is arranged two of face and one of back, and the back warp is stitched with a twill. Fig. 213 shows a design for backing the cassimere twill with warp, the backing warp being tied once in eight picks, and the design arranged one of face and one of back.

Fig. 214 is a design for a basket weave backed with the eight end satin weave in the warp, the design being arranged two of face and two of back.

972. The method of designing warp backed fabrics having been dealt with, the method of making the harness and chain drafts with which they are woven will be explained.

973. It will be remembered that in the case of filling backed weaves, only as many harnesses were required to weave the design as the face weave alone required.

974. In the case of warp backed fabrics, however, it is clear that as the backing warp always interlaces with the

filling differently than the face warp, it must be drawn in on separate harnesses.

975. A warp backed weave may be drawn in exactly as a single cloth, if it is so desired. In this case if the weave is arranged one of face and one of back, the first harness will be a face harness, and the second harness will have the backing warp, and so on, each alternate harness being a backing harness.

976. The above method of drafting is adopted in some instances in connection with warp backed fabrics of simple design, but in the majority of cases it is desirable to separate the back harnesses from those through which the face warp is drawn.

977. This is desirable, since it makes the harness draft much simpler for the weaver, thus rendering the liability of broken back warp ends being tied in on face harnesses, or vice versa, less probable.

978. There are two methods of separating the backing harnesses from the face, the first being that of drawing the back warp in on the back harnesses, and the second being that of drawing the back warp through the front harnesses.

979. Both of these methods are largely in use, but for certain reasons the latter method is to be preferred. By drawing the backing ends through the front harnesses, they are more readily accessible to the weaver, and as the backing ends are often of poorer material, and thus break oftener, this is somewhat of an advantage.

980. For the same reason, namely, that the backing ends are often weaker than the face ends, it is of an advantage to place the backing warp on the front harnesses, since the back harnesses are lifted higher during weaving, thus bringing more strain on the yarn drawn through them.

981. The method of making the drafts for a warp backed fabric will be explained, taking Fig. 211 as an example.

982. The first step is to make the harness draft. This is accomplished in the same manner as when dealing with single cloths, except that two processes are required in order to draft both the face and back weave.

983. In drafting this design, the back warp will be placed on the front harnesses, and consequently will be drafted first. Since in this example the backing weave is an eight harness satin it will require eight harnesses.

984. Proceed exactly as in single cloth, taking care, however, as this weave is arranged one of face and one of back, to leave every other vertical row of squares on the design paper for drawing in the face warp.

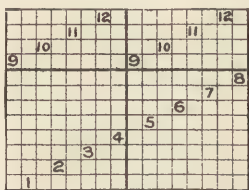


Fig. 215.

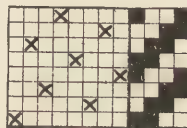


Fig. 216.

985. Next make the harness draft for the face weave, placing it above the draft for the back weave, but upon the vertical rows of squares reserved for the face warp.

986. As the face of Fig. 211 is a four harness weave, there will be two repeats of the face drawing-in draft to one of the back.

987. The complete drawing-in draft for Fig. 211, obtained as explained above, is shown at Fig. 215, the back warp being drawn in on the front harnesses.

988. In making the chain draft, the same system as that which was explained in connection with single cloths is adopted, and since the warps have been separated and drawn in on separate harnesses, then the face and back weaves will also be

separated in the chain draft. Fig. 216 shows the chain draft for Fig. 211, drawn in according to the harness draft shown at Fig. 215.

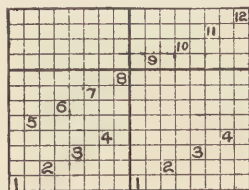


Fig. 217.

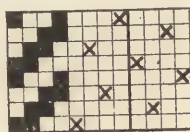


Fig. 218.

989. If it were desired to draft Fig. 211 with the back warp drawn in on the back set of harnesses, the harness draft would be made as shown at Fig. 217. When making the chain draft for Fig. 211, according to the harness draft shown in Fig. 217, the same method as with single cloth is observed, as previously explained.



Fig. 219.

The chain draft for Fig. 211, with the backing warp drawn in on the back harnesses, is shown at Fig. 218.

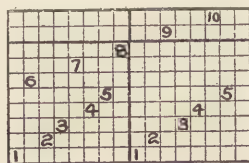


Fig. 220.



Fig. 221.

990. When drafting warp backed weaves which are arranged two of face and one of back, the same methods are employed as those previously explained, except that two face

ends are placed consecutively on the drawing-in draft, in accordance with the design.

991. The method of making this style of drawing-in draft is shown at Fig. 220, which is the drawing-in draft for Fig. 219. The chain draft for Fig. 219, according to the drawing-in draft shown in Fig. 220, is shown at Fig. 221.

EXAMPLES FOR PRACTICE.

992. 1. Back the $\frac{4}{2}$ regular twill with warp, arranging the design one of face and one of back. Tie each backing end perfectly.

2. Back the $\frac{4}{2} \frac{3}{3}$ regular twill with warp, arranging the ends one of face and one of back. Tie the backing warp in 12 end satin order.

3. Make a design for a warp backed fabric having the $\frac{3}{1}$ regular twill on the face and the 8 harness satin weave on the back, arranging the warp ends one of face and one of back. Show harness and chain drafts with the back warp drawn in on the front harnesses.

4. Back the $\frac{4}{1}$ regular twill with warp, arranging the design one of face, one of back, one of face. Tie the backing warp in 5 end satin order. Show harness and chain drafts with the face warp drawn in on the front harnesses.

993. *Piqués* are cloths which cannot strictly be called filling backed or warp backed cloths, but they have features which are similar in many respects to both of these types which have been explained in this lesson.

994. Thus, for instance, a *piqué* cloth will be found to have a separate system of filling, which is known as the **wadding** filling. In this respect it resembles a filling backed fabric.

995. Again, a piqué will be found to contain a separate system of warp ends, in which respect it resembles warp backed fabrics, but unlike warp backed fabrics, these backing ends in piqués are for the purpose of holding the wadding filling, also to cause ridges across the cloth, and not to add any weight or warmth to the fabric.

996. Since these cloths are largely manufactured for the cotton trade, a description of the weave will be explained here, each step being fully shown.

997. In making a design for a piqué, there are several different steps which should be carefully noted.

First. When starting to mark the design on design paper, mark the *vertical* row of squares on which are to be placed the *face* ends, and also the *vertical* row of squares on which are to be placed the *backing* ends. This can be done by shading one set of squares, the same as was done when making warp backed designs. The proportion of face ends to back, in piqués, is generally *two of face* and *one of back*, that is, every third end as marked on the design paper will be a backing end.

Also indicate in some manner the picks on which the wadding filling is to be inserted.

Second. Place the face weave on all the face ends, neglecting the backing ends and wadding picks entirely. This is done in exactly the same manner as was explained with warp backed fabrics.

The face weave of piqués will generally be found to be the plain weave, although this is not always the case.

Third. Raise all the face ends on the wadding picks. In order to do this it will of course first be necessary to determine which are the face and which are the wadding picks. This will depend to a large extent on the kind of yarn which is to be used for the wadding. In case it is coarser than the yarn for the face picks, then the proportion is generally *two of face to one of wadding*, although different proportions are

used to suit different requirements. It should also be understood by the student that the face and wadding picks may not be arranged two and one, and yet the *proportion* can be two to one.

Fourth. In addition to the face and wadding picks, there are what are known as the **cutting** picks. These are the picks on which *the backing ends are brought to the face for the purpose of pulling the face cloth down between the wadding picks*, thus forming furrows across the cloth.

These cutting picks are also the face picks. That is, the face weave will be placed on these picks and in addition the backing ends will also be raised to the surface of the cloth.

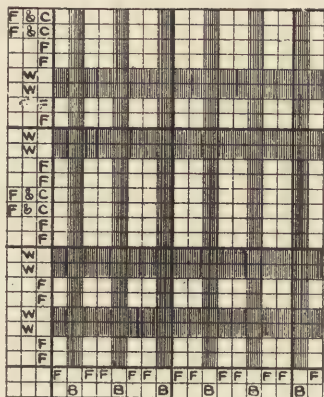


Fig. 222.

998. The number of picks between the cutting picks is determined by the design which is to be woven. Again, in some cases all the backing ends are not raised on the same picks, but are distributed over the cloth and by this means form fancy raised effects.

999. However, in determining which picks shall be the cutting picks, one point should always be observed. If possible, *have at least two picks of the face weave between the wadding picks and the cutting picks.*

1000. A simple piqué design will be constructed, taking up each step as outlined above.

Fig. 222 shows the design paper marked out for a piqué design occupying 18 ends and 24 picks.

It will be noticed that shaded squares indicate on which are to be placed the backing warp and the wadding filling. The ends and picks are also marked with the letters, F, face, B, back, W, wadding, F and C, face and cutting.

1001. It should be stated that several repeats of the design will be shown here, in order that the student may obtain a better idea of the construction. Piqué designs, however, are as a rule complete on a very small number of ends.

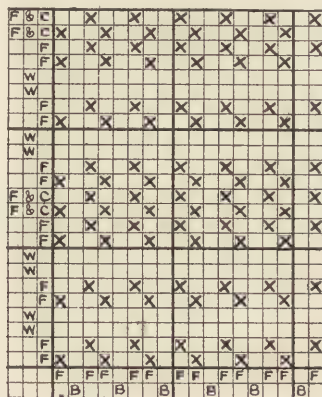


Fig. 223.

1002. The next step in the formation is the *placing of the face weave on the squares which are not marked for back ends and the wadding picks.*

It will be assumed that the face weave is to be the ordinary plain weave. Fig. 223 shows the design with the face weave inserted.

1003. The next step is to *raise all the face warp on the wadding picks*, but since the method of doing this is identical with that explained in connection with the raising of the warp yarn on hacking picks, when making filling backed designs, this will need no illustration here.

1004. The next step is to *raise the backing ends on the cutting picks*. This would mean that the backing ends are to be raised on the eleventh and twelfth, also the twenty-third and twenty-fourth picks.

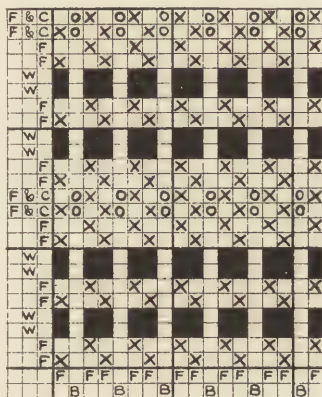


Fig. 224.

1005. Fig. 224 shows the design complete, and by referring to this figure a description of the manner in which the cloth is woven will be given.

1006. The first two picks are plain, the backing ends being down and consequently not showing on the face at all.

On the third and fourth picks the wadding is inserted. While this is done all the face warp is raised and the back warp is down, consequently the pick of wadding will lie in between these two series of yarns, and will not show on the face, but being heavier than the face yarns will tend to *raise* the cloth constructed by the face weave.

The next six picks are but repetitions of the first four.

1007. On the eleventh and twelfth picks, however, in addition to the plain weave of the face cloth, the backing warp is brought to the surface. These are the cutting picks.

In weaving a piqué design, the backing warp is generally placed on a *separate beam which is weighted heavier than that containing the face warp*, thus causing the backing warp to be under greater tension.

1008. When this backing warp is brought to the face, being under greater tension, it will of course tend to *draw the face yarns down*, thus causing a furrow between those parts of the cloth which contain the wadding picks.

1009. The next twelve picks are but repetitions of the first twelve, and consequently need no further explanation.



Fig. 225.

1010. When trying to understand the construction of a piqué design, it should be understood that the wadding picks do not show on the face of the cloth at any point, simply lying between the face and back ends. Again the backing ends do not show on the face of the cloth at all except where they are raised for the purpose of pulling down the face cloth.

1011. Consequently the face of a cloth woven with a design such as the one shown in Fig. 224 would be similar to plain cloth, with the exception of the raising of the cloth into ridges through the effect of the wadding picks, and also the floating of the back warp over two picks.

1012. The relation which the different ends and picks bear to each other when woven into cloth is more clearly illustrated in Fig. 225, where a sectional view of 3 ends and 24 picks is shown.

1013. In this illustration the heavy dark line represents the backing end, while the other two running in the same

direction show two face ends. The larger cross sections, marked W, show the ends of the wadding picks, while the smaller cross sections show the face picks.

1014. By referring to this figure it will be readily seen how the face picks, interweaving with the face warp, crowd over the wadding picks, thus hiding them. It will also be seen how the backing end rising over the interlacings of the face filling and face warp, draws them down, thus forming a furrow across the cloth.

1015. When dissecting fabrics of this type of goods, the following points will be found to be of considerable assistance to the student.

First. *Find the proportion of face ends to the back ends.* This can be done by counting on the back of the cloth the number of backing ends per inch, then counting on the face of the cloth the number of face ends per inch.

Suppose for an example that there were found to be 30 backing ends and 60 face ends in an inch, then it would readily be seen that there were two face ends to every backing end. The design could be marked out in this manner.

Second. *Find the proportion of face picks to wadding picks.*

In the design shown in Fig. 223, it will be seen that there are 16 of face to 8 of wadding.

Third. *Find the weave for the face cloth*, which in this case is plain, and place it on all of the face ends, omitting the wadding picks.

Fourth. *Find the order of raising the back warp into the face.* This can readily be done by taking a small part of the sample, the wrong side up, and pulling out the ends, one by one, instead of the picks, noting on the design paper whenever a back end is raised into the face cloth.

Fifth. *Raise all the face ends on the wadding picks.*

1016. In making the harness and chain drafts for a piqué design, the following points will be of assistance to the student.

The *backing* and *face warps* are drawn through separate sets of *harnesses*, the same as was explained when dealing with cloths backed with warp, with the exception, however, that in piqués the *backing warp* is generally drawn through the *back harnesses*, and the *face warp* through the *front harnesses*.

1017. As was stated previously, the proportion of face to back ends in piqués is generally two of face to one of back. Again the face and back warps are generally of the same material, consequently the reasons for drawing these warps through the harnesses as explained is readily apparent.

1018. When piqué cloths are arranged two of face to one of back, they are as a rule reeded *three in a dent*, that is, two face ends and one back end are drawn in each dent of the reed, in such a manner that there will be one face end on each side of the back end in the reed.

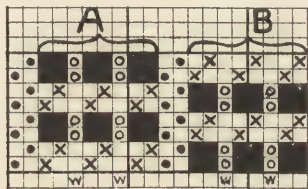


Fig. 226.

1019. Piqués are *high pick* goods, the number of picks per inch being largely in excess of the number of ends per inch.

1020. Bedford cords have the same general appearance as piqués, with the exception that the furrows run *lengthways* of the cloth instead of across the cloth. Although Bedford cords and piqués have the same general appearance, with the exception noted above, their construction will be found to differ to a very large extent.

1021. For example, in Bedford cords there will be found to be *wadding ends* instead of wadding picks. These wadding

ends are held in the cloth by means of the same picks that form the face of the cloth, instead of using backing picks.

1022. *Two ends working plain throughout the entire length of the cloth* form the furrows.

1023. A design for a Bedford cord weave will be given here and each series of ends and picks fully explained, in order that the student may obtain a good idea of their construction.

1024. Fig. 226 shows a Bedford cord design. The student should understand that in both piqués and Bedford cords the face of the cloth generally shows a plain weave, and that while in the piqués the furrows run across the cloth, in Bedford cords they run lengthways of the cloth.

Fig. 226 shows one repeat of the design in its ends, while two repeats of the picks are given.

1025. By noticing this design it will be seen that the first and second ends, also the eleventh and twelfth, work plain throughout the cloth. These ends form the furrows lengthways of the cloth, while the weaves between them form the ridges. It will be noticed that the parts of the design between the ends working plain are marked respectively A and B.

1026. Dealing first with section A, it will be seen that the ends 5 and 8 are marked W, which indicate that they are the wadding ends.

1027. Dealing now only with ends 3, 4, 6, 7, 9 and 10, it will be noticed that they work plain on the first and second picks, and are all raised on the third and fourth picks. This being one repeat of the design in its picks, the others are only repetitions of these first four.

1028. The effect of raising the ends in this manner is to cause the second and fifth picks, also the first and sixth to come together, and thus produce a plain weave on the face of the cloth.

1029. It will also be noticed that on those picks on which all these ends are raised, the wadding ends are also raised.

The filling floating at the back will in this manner bind the wadding ends between the face cloth and these picks of filling, not allowing the wadding ends to show on the face and yet holding them securely in position.

1030. Referring now to the section marked B, it will be seen that this corresponds with A, with the exception that *the position of the picks is reversed*. Thus while in section A the face ends are working plain, in section B they are all raised, also while in section A all the face ends are raised on the third and fourth picks, in section B they are working plain. Thus the same picks which are weaving plain to form the face cloth in section A are floating at the back to hold the wadding ends in section B, and the reverse is also true.

1031. The ends 1, 2, 11 and 12 which work plain throughout the cloth should work *tighter* than the rest of the ends in the warp, in order to make the furrows between those parts of the cloth which contain the wadding ends.

1032. All Bedford cords are made on the same general principles, and by studying the construction of a few of these cloths the student should readily understand the weave.

1033. In dissecting a cloth of this character the following points will be found to be of assistance.

First. Notice the ends which work plain throughout the weave, and which form the furrows running lengthways of the cloth. These are the ends which correspond with ends 1, 2, 11 and 12 in Fig. 226.

Second. Count the ends which are working plain on the face of the cloth, in the raised portion between the furrows. It will be seen that in Fig. 226 there are six. Then by looking at the back of the cloth the number of wadding ends can readily be determined, thus learning the proportion of face ends to wadding ends.

Third. Arrange the ends on the design paper after the manner shown in Fig. 226, taking care to have the wadding

ends come between the face ends, and also to have the face ends which are working plain in one section raised in the next, and vice versa.

1034. The student should understand that it is not possible to pick out one of these cloths in the same manner as is done with cloths containing but one system of warp and one system of filling, but that by having a good general knowledge of their construction it is possible to learn the weave of any sample by simply studying the cloth by means of a pick glass.

1035. Bedford cords are *high sley* goods, and the number of ends per inch is always in excess of the number of picks per inch.

1036. In regard to the drawing-in draft, it should be stated that the wadding ends are generally drawn through the back harnesses, while the face ends are drawn through the front harnesses.

In reeding these cloths each wadding end should be drawn into a dent with two or more face ends, if possible.

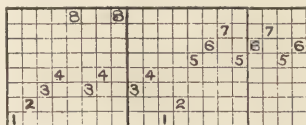
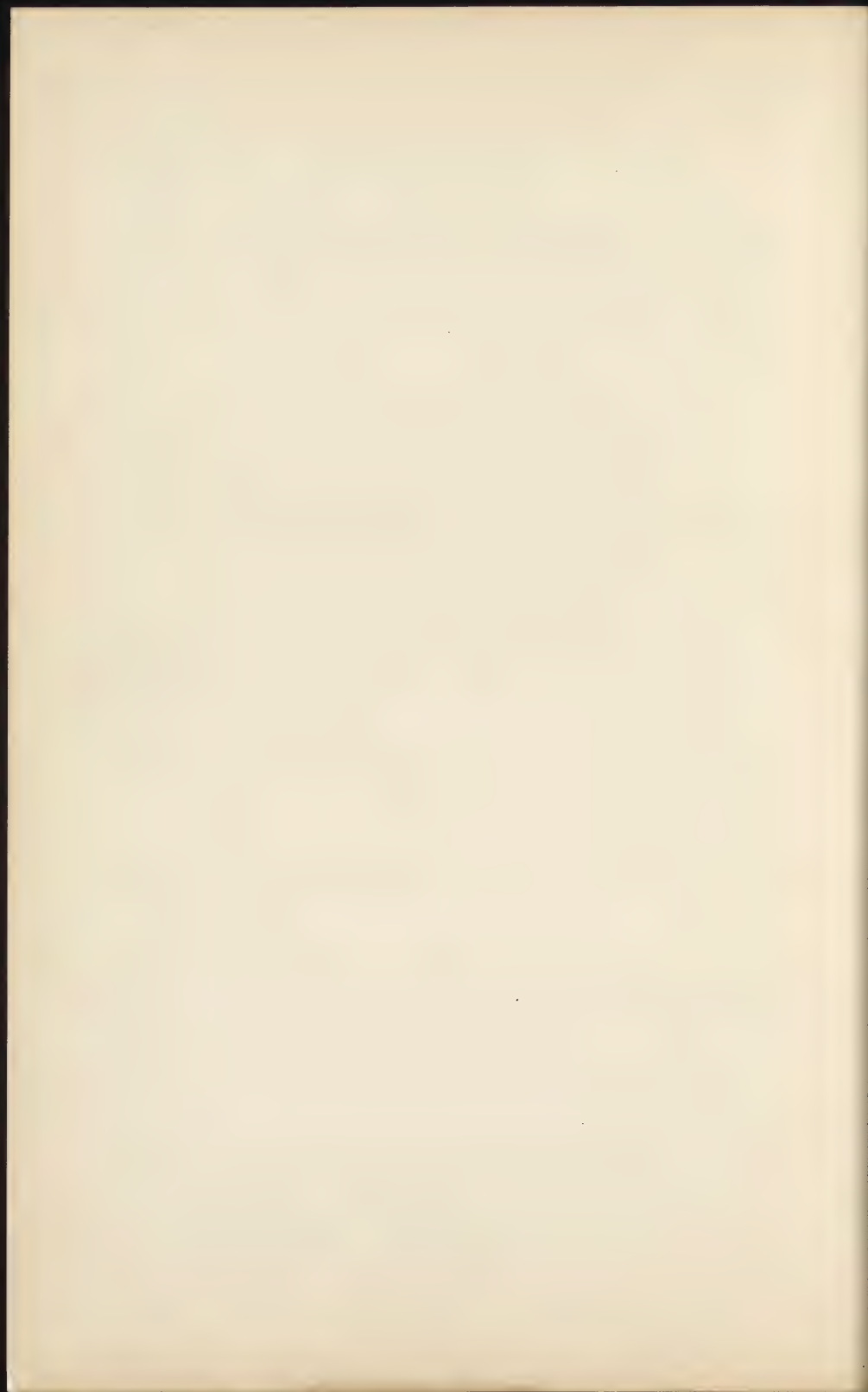
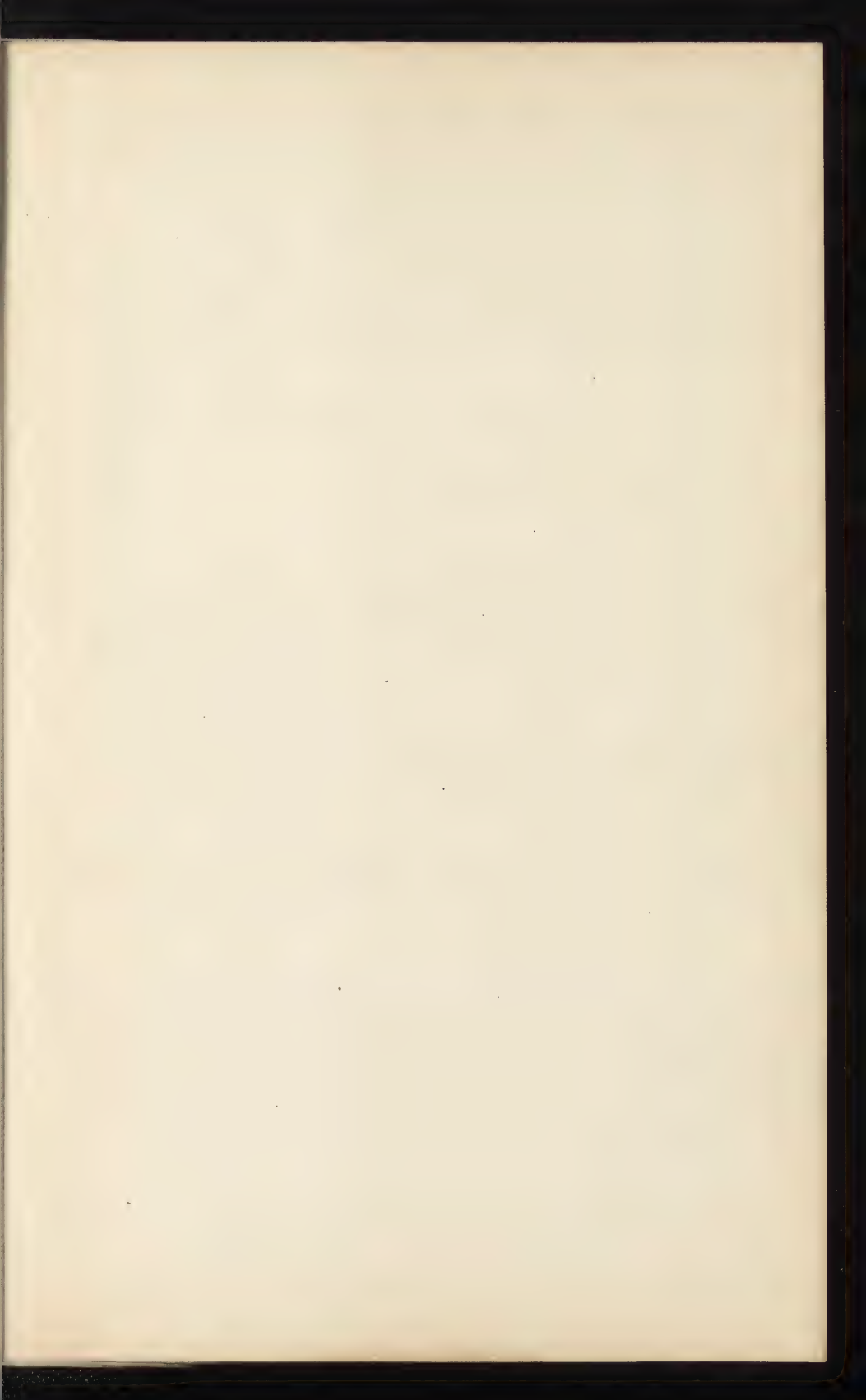
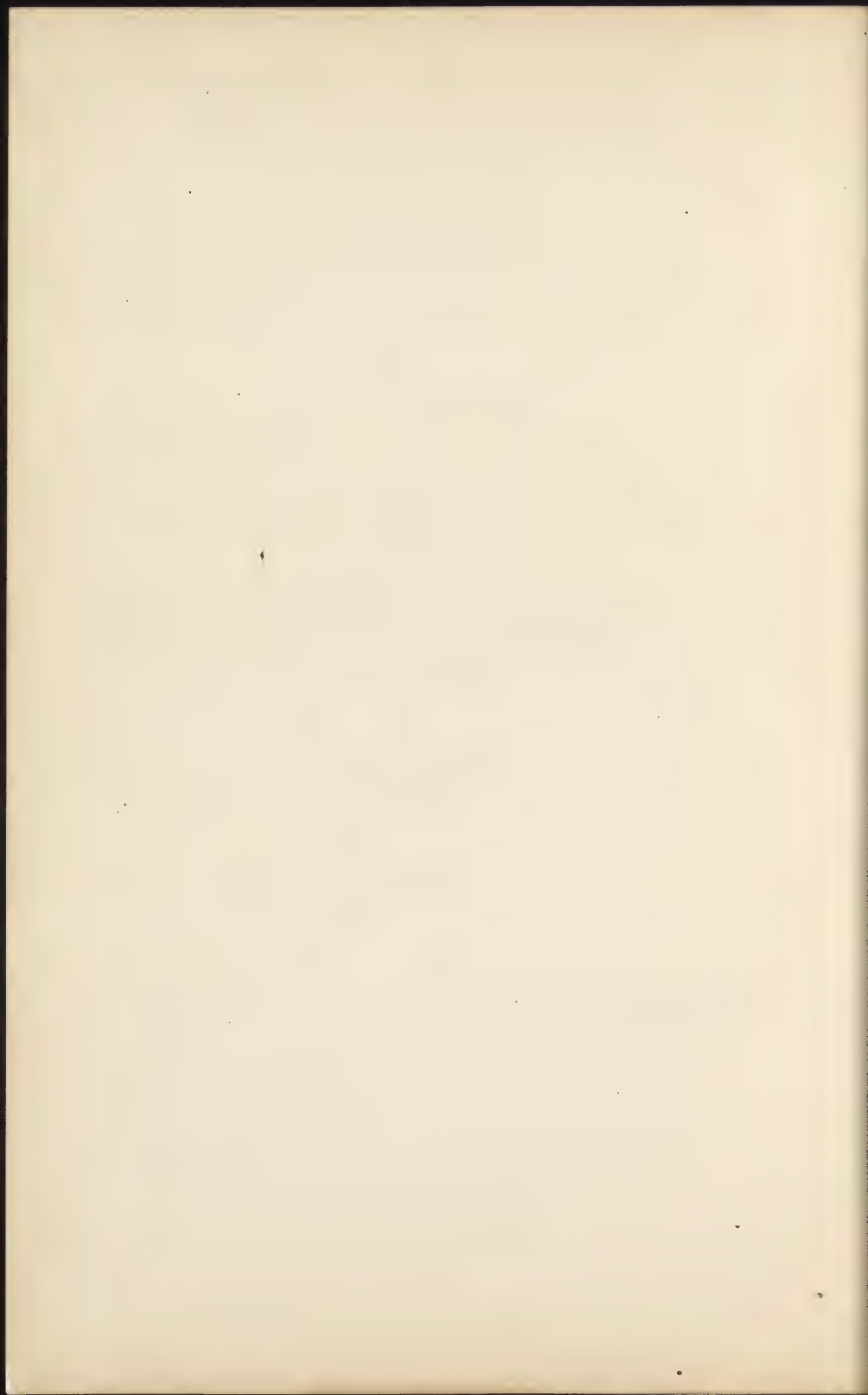


Fig. 227.

1037. Fig. 227 shows a drawing-in draft for Fig. 226. In reeding the ends when drawn in in this manner, the best plan would be to draw five in a dent, commencing with the 2d end. That is, ends 2, 3, 4, 5, and 6, would occupy one dent, ends 7, 8, 9, 10, and 11 another, ends 12, 13, 14, 15, and 16 another, and ends 17, 18, 19, 20, and 1 another. This will bring each wadding end in a dent between two or more face ends.







The
American
Correspondence
School of
Textiles,
New Bedford, Mass.

INSTRUCTION PAPER.

TEXTILE DESIGNING.

SUBJECT:

DESIGNERS' REQUIREMENTS.

FIRST EDITION.

NOTICE.

The student must, in accordance with his agreement, treat this instruction paper as confidential, and not allow it to be used by any other person for study or other purposes.

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S. 452.

DESIGNERS' REQUIREMENTS.

1. Picking out a sample of cloth, reproducing the same, and originating new weaves should not be considered as all the requirements of a good designer, as there are many other things which must be understood before a man can become competent in this branch of textile work. In fact it may be said that the more a man learns of all the branches of textile manufacturing, the better designer he will become, since if a person understands the processes through which fibres pass before becoming cloth, and the results of these processes, he will be better able to judge what combinations are best to form a fabric.

2. In addition to this, a designer should be a constant student of the market in order to know what effects and designs are especially salable, for although it is not always the case that the designer has complete authority to manufacture any grade or quality of cloth that he may desire, yet his opinions in regard to these points are often sought.

3. It is a good idea for any one studying designing, or seeking to obtain a position as a designer, to have a large sample book in which he can keep any samples of cloth which he may obtain, and also in the same book keep the pick out of these samples. These will be found to be of great aid when obtaining new weaves and new combinations of colors, for although the fashions of the previous season may not prevail the next year, still there will be found to be many good points which may be obtained from cloths kept in this manner.

4. Designers of long experience are well aware that there is a cycle of fashions in textile fabrics, that is, after a period of years certain styles of goods become fashionable again. The fabrics of to-day may have been in vogue 8, 10 or 15 years ago and will be again in a similar period.

5. Thus the history of previous seasons' styles as found in the old pattern books of the mills or in books formerly published containing reproductions of fabrics formerly in fashion, are well worth the attention of a designer.

6. In addition to being conversant with the different kinds of yarn manufactured in his own mill, the designer will also find it to be an advantage to understand yarns of different materials, since in many cases combinations of different yarns in the same fabric will be found, and if the best methods of combining different materials are understood, it will be much easier to make the combinations than though they had to be worked out to the best of his ability without this knowledge.

7. In short, it may be said that the duties of a designer are to reproduce samples of cloth and originate new weaves, yet in order to do this correctly, it is also his duty to understand all the processes which lead up to the making of perfect cloth.

8. Samples of cloth are often sent to the mill by the selling agent, with directions to reproduce these samples in certain lines. That is, it may be desired to produce a fabric which will be similar to the sample in appearance and yet one which can be sold at a lower price, or in other cases it may be desired to use a sample simply for the combination of colors which it may contain, or again simply for the weave with which it may be woven, and still in other cases orders may be given to the designer to simply reproduce the sample. In all of these cases it is his duty to reproduce such cloth as may be desired.

9. It will be the object of this lesson to explain the method in which a small sample of cloth is taken by the designer and reproduced or new designs formed from it, also giving a general idea of the manner in which a designing room should be equipped to obtain the best results, the manner in which it should be arranged, and the help necessary to produce the required samples.

10. However, it should be stated at the beginning, that different mills have different arrangements, and as it is not possible in this lesson to explain each and every one, only a few of the best will be described, and from these it will be possible for the student to recognize any others which may be met with.

11. Arrangements which may be the best for a mill arranged to make certain kinds of cloth would not be the best for another mill which is arranged to manufacture an entirely different class of fabric. However, if the student fully understands the processes which will be explained in this lesson, he will be able to adapt himself to any methods which he may have to deal with.

12. The designing departments of a mill should consist of two rooms at least, that is, a room for the designer himself and an

assistant if necessary, and another room which may be termed his weave room. In many mills it will be found to be the case that the designer's room alone serves the purpose, as his samples may be woven in the main weave room of the mill, in which case of course it would not be necessary for the designer to have a weave room of his own.

13. However, it is generally found to be the better plan to have a room separate from the rest in which the samples of cloth may be woven, and which may be under the direct supervision of the designer, and this will be the method which will be described in the following lesson.

14. These two rooms, that is the designer's room and his weave room, should be in a part of the mill where good light may be obtained, and it would also be an advantage to have them painted white on the inside in order to give better light. If possible it is the best plan to have these two rooms adjoining and glass windows between the two in order that the designer may have direct supervision over the weave room even while he is performing his other work.

15. First dealing with the designer's room, this should have at least the following equipment:

- A long flat table,
- An examining table,
- Yarn scales,
- Cloth scales,
- A yarn reel,
- A yarn testing machine,
- A cloth testing machine,
- Record books,
- Lay-out sheets,
- Pick glass,
- Pick-out needle,
- Design paper,

Sample cards or books of the different yarns manufactured in the mill, and many incidentals, such as pens, ink, paper, etc.

16. The first of these articles mentioned as being requisite, that is the long, flat table, will be found to be of general advantage and especially useful in measuring and folding the cloth samples. The examining table is used for the purpose of inspecting all cloth after it is woven. It should have an inclined slope at an angle of from 30 to 40 degrees, and it is also an advantage to have one half of the table painted black and the other half white, as by this means

cloth containing dark colored yarns may be readily inspected on the white part of the table, while cloths containing light colored yarns may be inspected on the dark part of the table.

17. Cloth to be inspected is pulled over the table slowly, and as it passes over the dark and light background it is very easy to notice any defect which it may contain. It is best to have the table situated in such a position that the person examining the cloth will have a good light at his back.

18. The objects of yarn scales have already been explained in previous parts of designing, and it is not necessary to point out to the student the necessity of having a pair of these in order to ascertain the counts of any yarn which may be used. Fig. 1 shows an illustration of a good type of yarn scales.

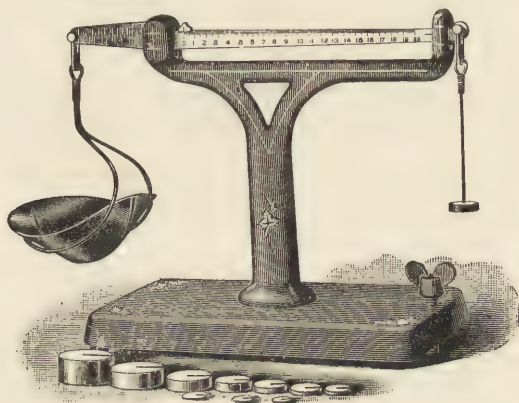


Fig. 1.

19. The necessity of cloth scales will also be readily understood since cloth samples must always be made to a certain weight, and in order to obtain this result, the cloth must be weighed both after weaving and after finishing. The scales shown in Fig. 1 can be used for weighing cloth as well as for weighing yarn, since they are made to determine the weight to tenths of grains, and accurate results can therefore be obtained.

20. Yarn reels, or as they are sometimes known, wrap reels, are used to measure off a definite number of yards of yarn, when desiring to test the yarn to determine its breakage weight. A good type of yarn reels is shown at Fig. 2.

21. A yarn testing machine is necessary in order to ascertain whether the yarn being used is up to the standard or not.

Fig. 3 shows a yarn testing machine. After the yarn is taken from the yarn reel it is placed upon the two hooks of the yarn testing machine and by turning the handle until the yarn breaks, the breaking weight of the same is shown by means of the finger and dial.

When finding the breaking weight of cotton yarn it is the custom to reel 120 yards. For testing worsted the length reeled is 80 yards.

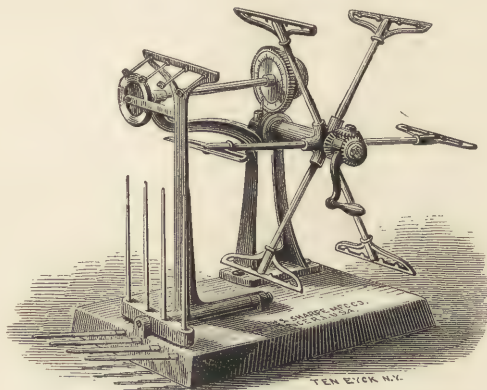


Fig. 2.

22. Another type of yarn testing machine which may better be termed a yarn examining machine is shown in Fig. 4. In this machine the yarn is wound from the bobbin, or cop, on to a card in such a manner that there will be only one layer of the yarn. When placed upon the card in this manner any imperfections, such as thin places, specks, etc., will be readily noticed.

23. A cloth testing machine is used for the purpose of determining the strength and elasticity of the fabric. In the manufacture of a large variety of cloth it becomes an important matter to determine the strength and elasticity of the same, and in many cases an order is placed with the mill, in which it is stipulated that the cloth shall have a certain strength and elasticity. This is especially the case with the manufacture of army goods.

24. Breaking tests afford a very certain proof whether the bleaching processes through which the cotton and linen goods have passed have been rational ones, that is, whether the goods have been weakened or not. Fig. 5 shows a good type of cloth testing machines.

25. The sample of cloth to be tested is evenly fastened between the jaws C^1 and C^2 . The exact distance between them, for example say 16 inches, is ascertained at the outset by reference to the graduations on the guide rod E. The cloth is then strained or stretched by turning the handle F until it begins to tear, the tension being registered on the dial blade in units of weight.

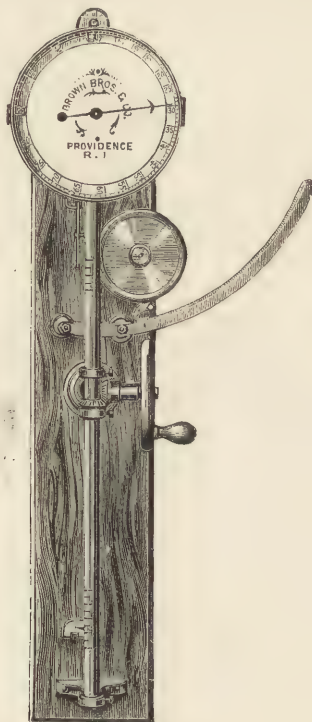


Fig. 3.

26. The detents G prevent the pointer from receding after the cloth has torn and the elasticity is ascertained by the difference between the initial and final length of the sample as measured on the guide rods.

For example, suppose the first length of the cloth was 16 inches and the length at which it tore was $17\frac{1}{8}$ inches. Then the elasticity equals $1\frac{1}{8}$ inches, or about 7 per cent.

27. To readjust the spring and balance to zero, the wheel F is reversed until the jaws C^1 and C^2 can be connected by the piece H,

the spring being then drawn in slightly to lessen the detent G and afterwards allowing it to recoil by reversing the wheel F.

28. Record books should be kept by all designers in order to have an accurate record of all samples previously made, which may be readily referred to at any time, and which also will be a great guide in making future samples. These record books may be considered another style of the sample book which was spoken of at the beginning of this lesson and should be carefully numbered and indexed, in order that any style or pattern may be readily referred to.

29. Lay-out sheets are employed by the designer in making out directions for warping the yarn which is to be made into samples of cloth. These will be spoken of later and a sample of the same shown.

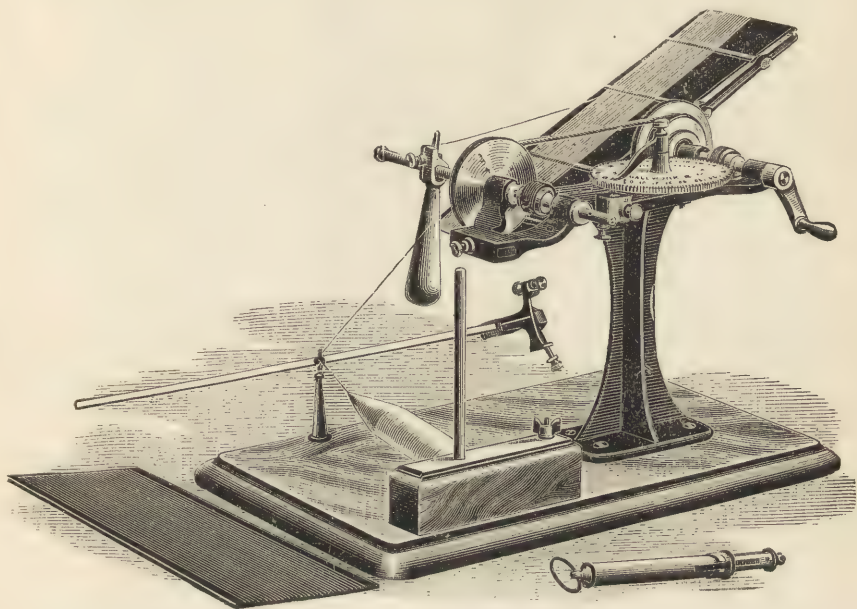


Fig. 4.

Pick glasses, pick out needles and design paper, the student should be thoroughly familiar with, since the objects of these have been fully explained in previous lessons.

30. Sample cards of yarns are simply strips of card board around which samples of each different color, or different count of yarn, which the mill is using are wound. These are arranged so that they will enable the designer to see at a glance which colors are at his disposal, and they are also of some aid when desiring to learn

how the colors will look when arranged in the cloth. Yarns are frequently arranged in books, and when this is the case, the book serves the same purpose as the cards just described.

31. The designer's weave room should contain all the articles and machines necessary for making samples of cloth from the yarn. In many cases the different counts and colors of yarn which are made in the mill will be placed on small spools and these spools kept in boxes or drawers in the designer's weave room. The boxes contain-

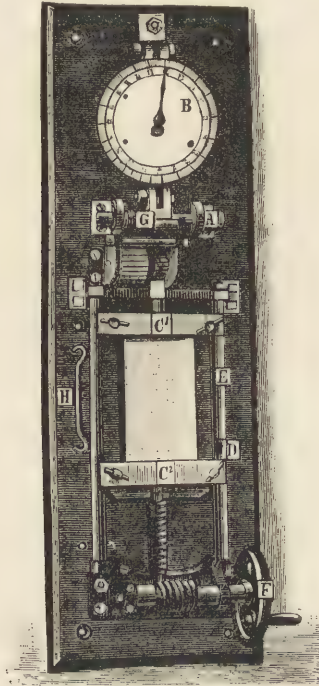


Fig. 5.

ing these spools should be labeled on the outside in order that a person may readily tell what color and what counts of yarn they contain. They should be kept systematically and readily accessible so that when it is desired to make a warp there will be no hindrance on account of the yarn at hand.

32. The designer's weave room often contains a small slasher arrangement which is used for the purpose of sizing or dressing the warp yarn which is placed on spools. These spools are placed in a creel at the back of the machine and run through the sizing arrange-

ment on to spools at the front. It must be understood that this method of sizing is not as advantageous as that done in a regular slasher but serves the purpose nearly as well and lessens the cost to a considerable extent.

33. Almost every designer's weave room will be found to contain a warping arrangement by means of which the designer may make his own warps. As these warps are not generally over 9 yards in length, the saving in expense and trouble when made in this manner will be very apparent.

The manner of making these sample warps will be fully explained later when the reproduction of a sample is taken up in its details.

34. In addition to the machines already mentioned the weave room should of course contain looms on which the sample warps may be woven. It is very apparent that it is necessary to have looms in this room on which any kind of cloth made in the mill can be reproduced; that is, if the mill is running dobby work it is necessary to have a dobby loom, or if running box work it is necessary to have a box loom.

In short it should be possible to manufacture in this weave room any kind of cloth that can be made in any other part of the mill.

35. In regard to the location of the looms it is the best plan to have each loom near a separate window where a good light may be obtained. There should also be plenty of space at the back of the loom, the object for which will be seen from a later description.

36. In regard to the help required for this weave room there should be at least one man for each loom. If the sample warps are made in this room there should also be a man for this purpose alone. A boy will generally be found sufficient to run the sizing machine.

37. There should also be a fixer for the purpose of putting in the warps, building the harness and box chains and keeping the looms running. In many cases where only one or two looms are employed this last man may be dispensed with, as the weaver himself may be competent to look after this part of the work with the aid of the designer.

38. The arrangement of the designer's apartments, also the equipments of the same having been dealt with, the processes through which a small sample of cloth passes before it becomes a product of the mill will now be considered, each step being taken up.

39. As previously stated it is very seldom that the designer has complete control over the class of goods which the mill makes. In

the majority of cases the selection of a new line of goods is dependent upon the opinions of either the agent or the commission house.

40. In America today the styles of cloth that are manufactured are to a large extent derived from the styles of Europe and consequently it is an advantage to a person in this country to know as soon as possible what kind of styles and fashions are selling in Europe. There are several French firms with headquarters in Paris and branch offices in the United States that make a business of selling foreign samples to the mills and no matter what kind or style of cloth is desired it can be readily obtained. These samples are as a rule high priced fabrics, being perhaps selling samples of some other firm. In other cases they are sent direct from Europe, some of the larger mills keeping agents there permanently for this purpose and others sending men there occasionally to obtain ideas. As many lines of goods that are fashionable in Europe one season are in vogue in America the next, the advantage of obtaining these samples is obvious.

41. In the cotton trade it will often be found the case that simply sketches on paper are sent to the mill by the commission house with directions how to produce samples similar to those represented by the sketches. This is usually done where small striped effects are desired, such as satin stripes combined with the plain weave. In such cases the width of the different stripes will be designated and it remains for the designer to produce a sample of cloth which will be similar to that desired.

42. When a line of samples is sent to the mill the designer first looks them over and selects those which in his opinion it will be possible for the mill to make. He then takes each one separately and reproduces it as accurately as possible.

43. It will be supposed for an illustration that a certain sample of cloth has been selected which it is desired to reproduce. The designer first dissects this sample in order to ascertain the weave and the arrangement of the yarns in both the warp and filling. It is to be supposed that the cost of manufacturing cloth similar to this sample has been estimated and is found to be satisfactory, and also that it is possible to obtain the necessary yarns for the same as regards color, counts and quality.

44. After finding the weave, also the warp and filling patterns, the necessary specifications are then made out on the lay-out sheets.

Fig. 6 shows an ordinary type of lay-out sheet.

45. In this connection, however, it should be stated that when making these samples, which are known as trial samples, the size of each sample is very small, in some cases not being more than 6 inches wide. When such is the case it is generally the custom to make up a large number of samples in one warp. These are known as blanket warps.

46. For an example, suppose that a number of different patterns are to be made with the same warp, each of which is 6 inches wide. The first 6 inches of the warp, counting width way of the cloth would consist of one sample, the next 6 inches would consist of another, and so on until the whole width of the warp was occupied. By this means it will be seen that several samples would be obtained.

By referring to Fig. 6, it will be seen that three different warp patterns of the same style are shown, these patterns differing only in the colors used and their arrangement.

47. In cases where all the samples in a trial warp are of the same style, as is the case with Fig. 6, all the ends would, of course, have the same drawing in draft, and also the same chain draft. There are cases however in which different styles are placed in the same warp, and it then often becomes necessary to have more than one drawing in draft, and also to employ more than one chain draft when weaving the warp. The method in which these blanket warps are dealt with in the loom will be explained in connection with the weaving of the samples.

48. After the specifications have been made out by the designer they are next given to the person who makes the warps. The spools containing the necessary colors and counts of yarn are then selected from the boxes and placed on a creel in their proper order, that is, in such a manner that the ends may be taken from them in the order in which they should be arranged in the warp.

49. For an example, suppose that a warp was arranged 4 white, and 4 black. Then 4 spools containing white yarn would be placed in the creel in such a manner that they could be taken first by the person making the warp, and then 4 spools containing black yarn would come next.

50. In cases where cops of yarn are used in place of spools an arrangement consisting of wooden pegs is used. Such an arrangement is shown in Fig. 7.

51. In this illustration sufficient cops for a single repeat of the warp pattern are shown, the pattern to be arranged as follows: 4

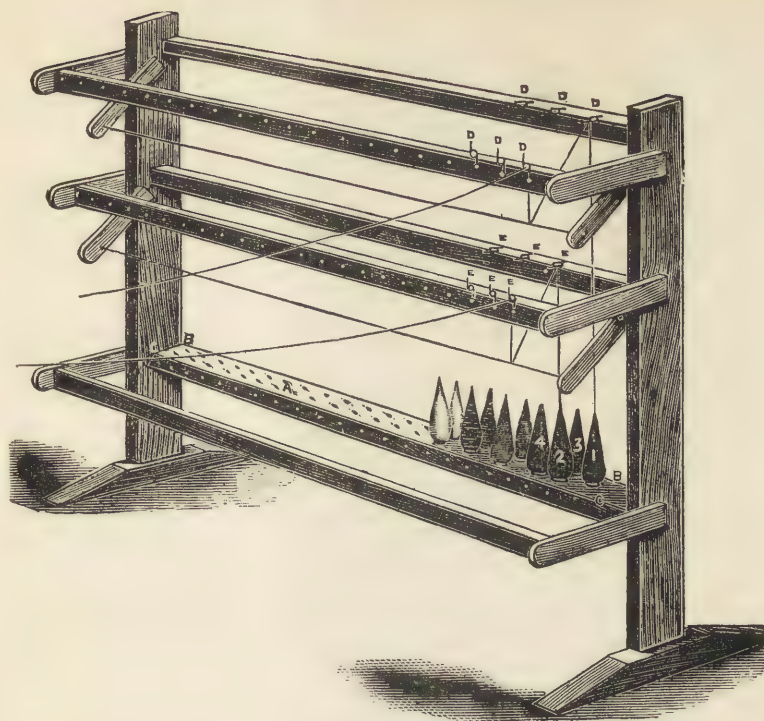


Fig. 7.

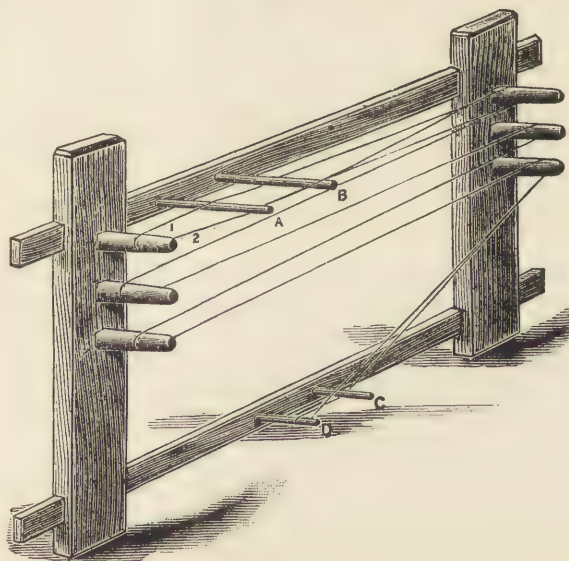


Fig. 8.

ends black, 2 ends gray, 2 black and 2 white. It will be seen by referring to this figure that the first cop is placed on the back row of pegs B, the second cop is placed on the front row of pegs C, the third on the back row, the fourth on the front row and so on.

52. Next the ends are taken from each row in successive order, that is the first end comes from the first cop on the back row, the second end from the first cop on the front row. The ends from the cops at the back are passed to the top of the creel through eyelets D while the ends from the front row of cops are passed through eyelets E.

53. The reason for thus arranging the ends is that it enables the person making the warp to easily form a lease which is necessary in order that the person drawing in the warp may find the separate ends readily.

54. Fig. 8 shows a warping arrangement which is in general use. In many cases this will be found to consist simply of pegs which are inserted in the wall of the room, around which the yarn from the spools or the cops can be passed. The person making the warp then selects the ends from the creel in their proper order, but in order to make the lease, passes the first end over the thumb and under the fore-finger, then the next end under the thumb and over the fore-finger, in this manner separating the even numbered ends from the odd numbered ones.

55. After the ends are selected in this manner they are passed around rods A, B in the same manner that they were passed around the thumb and fore-finger. Thus the rods A, B serve to form the lease of the warp and for this reason are termed lease rods. All of the yarn is then taken and passed around the pegs until it comes to the rods C, D.

56. As will be seen in the illustration the yarn passes under the rod C over the rod D then back under the rod D and over the rod C. By this means another lease is formed but is one which takes the yarn in sections, containing a larger number than was the case with the rods A, B, since the rods A, B separate the yarn thread by thread while the lease rods C, D separate the yarn by sections. This last lease is formed simply for the purpose of spreading the warp more evenly on the beam.

57. It will be readily seen by the manner in which the warp yarn is wound around the pegs, as shown in Fig. 8, that twice as many ends are obtained on the warper, as are taken from the creel, each time a person passes the yarn back and forth, since he commences and ends at the same place.

58. Referring again to Fig. 7 it should be stated that the number of cops shown here is by no means the total number that can be used at once. In fact several repeats of the warp pattern may be placed on the creel at one time and the ends taken from these.

59. Suppose for an illustration that the warp for only one sample is to contain 400 ends and one pattern is arranged in the same manner as shown in this figure. Then one pattern contains 10 ends. Suppose that 4 of these patterns can be taken from the creel at one time. This would mean that 40 ends are passed around the pegs at once and brought back which would give 80 ends of the warp. Then the person making the warp will select the ends for the 4 patterns the second time, and pass them around the pegs and back again, which will give 80 more ends or 160 altogether.

60. This is repeated a sufficient number of times to form all the ends in the warp. In this case there are to be 400, therefore the ends from the cops will have to be taken and passed around the pegs 5 times in order to give the required number.

61. If another sample is to be warped at the same time, consisting of different colors it will then be necessary to take the yarn from the creel and arrange the necessary spools or cops for the next warp. This is repeated until the different warps are made.

62. When taking the yarn from the warper the regular lease rods used in weaving should be inserted in place of the rods A, B, and C, D, also another rod inserted in the place of the first peg. The warp is then taken from the pegs and placed where it may be put upon a loom beam. In case the warp is not to be beamed as soon as it is taken from the warper, a string may be inserted in place of the lease rods, thus allowing the warp to be wound in the shape of a ball.

63. The loom beam generally rests on stands in such a manner that it can be turned by hand. The ends of the warp through which the rods C, D, pass are then fastened to the warp beam and the yarn is spread out by means of the lease rods at both ends of the warp. After it is spread out and each end thoroughly straightened it is wound upon the loom beam. Sometimes, as an aid to straightening the ends, a coarse heckling reed is used, the ends being spread evenly in the reed and drawn through the dents as they are wound upon the beam. This warp, together with the beam, is then taken to the drawing-in room where it is drawn in to the harnesses and reed in the manner that the specifications call for.

64. In some cases the warp may be drawn in in the designer's

weave room, although no expense is saved by adopting this method as the drawing-in of the sample warp is as much a regular process as the drawing-in of any regular warp for the weave room.

65. After being drawn in it is sent back to the designing room ready to be woven. The beam is then placed in the loom and the harnesses tied up ready for weaving. The necessary chains are built and placed upon the loom by the person who has charge of this, after which the first sample is woven.

66. It will be remembered that it was previously stated that several different samples are often combined in the same warp and in this case it will be seen that it is necessary to weave one sample at a time. Suppose one sample to contain a filling pattern of 4 black and 4 white; another sample to contain a filling pattern of 8 white and 8 black.

67. It is very apparent that it is not possible to weave both of these patterns at the same time since each pattern with a different filling must be woven separately. On this account when one pattern is being woven the rest of the patterns in the warp will be of no use. These are termed hybrids and are generally thrown away, although in some cases good samples are obtained from them, but this is the exception rather than the rule.

68. After the first sample has been woven with the necessary filling it is next necessary to weave the second sample. To do this it will be necessary to at least change the filling. In some cases it is necessary to even build a new box chain, and in very rare cases, where the sample warp contains different styles, it becomes necessary to build a new harness chain.

69. Suppose that there are six different patterns in a sample warp. By weaving the regular filling for each pattern six different samples will be obtained, but in many cases it will be found an advantage to change even the warp yarn in the sample warp. That is, after the six regular samples have been woven it may be left to the discretion of the designer to arrange different combinations of colors using the same weave.

When this is the case it is much cheaper to simply tie over the warp ends which it is desired should be changed, rather than make and draw in an entirely new warp.

70. To illustrate this point more fully, suppose that a certain pattern in the warp is arranged 4 black, 2 gray, 2 black and 2 white, and it is desired to change the two ends of gray to a different shade.

It is very apparent that it would be a much simpler matter to tie over these ends than to make an entirely new warp.

71. The manner in which this is accomplished is as follows :

The harnesses through which the ends of gray are drawn are raised while all the others are lowered, thus allowing the ends of the gray to be readily accessible. The person tying over these ends places a spool of the desired color on a wire rod which is placed over the loom for this purpose.

72. Two ends of the gray are broken out at once and one of these ends attached to the end of the spool. It is then carried some distance from the back of the loom around any object which may be placed at that point for the purpose, and back again to the other end of gray to which it is attached. The space allowed at the back of the loom which was previously spoken of is for this purpose, that is, to allow a person tying over the warp plenty of room in which to do so.

73. After all the ends have been tied in this manner the loose ends which were broken out, in this case the ends of gray which were in the warp, are drawn down under the beam and a weight attached to them in order to prevent them from passing up over the whip roll into the lease rods. The person then goes to the front of the loom and picks up the ends of gray in front of the reed by means of a wire rod after which they can be drawn through the reed to such a distance that the new ends will be even with the cloth previously woven.

74. These ends are then fastened to the warp by means of two or three picks of filling. The desired pattern of filling is now placed in the loom, when another sample of cloth is woven and after this sample has been woven other samples may be readily obtained in the same manner, and by this means a large number of trial samples may be obtained from one warp.

75. For example, suppose that this sample warp being dealt with contained six original patterns and that each one of these patterns was tied over three times. Then 24 trial samples would be obtained from the one warp. It may also be mentioned in this connection that in some cases the ends of the warp are tied over at the front of the loom instead of at the back. It will be seen that when this is done the entire length of the ends tied in, must be drawn through the reed and harnesses to the back of the loom, which is somewhat of a disadvantage.

76. After the entire warp has been woven in this manner the cloth is taken from the loom and carried to the designer's room where it is measured and weighed. It is then taken to the finishing room and after passing through the necessary processes is brought back again to the designer's room where it is again measured and weighed.

77. All the items obtained from these different measurements should be inserted in a book where they can be readily referred to in order that the effects of the different processes may be easily noted. The cloth is then cut up into samples and the best of them selected to be sent to the commission house. Several samples from this lot may be selected by the commission house as being suitable to put on the market.

78. As previously stated the samples so far dealt with are simply trial samples. After a certain number have been selected it is next necessary to make what are termed selling samples. These selling samples are generally woven the same width that they are intended to be woven for the market and they should pass through every process through which a regular cloth has to pass, since by this means only, the necessary information can be obtained in regard to the appearance of the cloth after being made and also the cost of manufacturing.

79. From these selling samples the agents' sample books are made. It then remains with the selling house to place orders for any sample of cloth which has been made.

80. After an order has been obtained for the mill, it is next the designer's duty to make out all specifications which may be necessary for the reproduction of the desired cloth. Those relating to the warping, beaming and drawing-in departments of the mill should be sent to the respective overseers, also all the specifications such as harness drafts and chain drafts should be sent to the overseer of the weave room.

81. When the cloth is first started in the weave room it should be the duty of the designer to see that the first pieces taken off are correct in every particular, after which it may be safe to assume that his duties as regards that special line of goods are completed.

82. By this time the student will have realized that designing is not a modern art. The Textile Museums of world wide renown, such as those in Florence, Italy, Crefeld in Germany, or the Museum of Fine Arts in Boston contain fabrics, some of which were manufactured centuries ago, exhibiting skill in designing, taste in coloring and knowledge of cloth structure equal to most modern fabrics.

83. It is not possible for every designer to visit such museums but in many of the public libraries in the larger cities there are books of decorative art or historic ornament in which many of these fabrics are reproduced, and an examination of which often leads to the formation of new ideas and is certainly a part of the education of a designer.

84. Textile designing is an art that has been developed to a high degree in Europe and the products of English, French and German designers are justly esteemed. In many American mills it will be found that the designers are of foreign birth, thus proving the fact that the services of European designers have been appreciated in American mills. It is therefore advantageous to designers in American mills to keep in touch with what is being done in Europe and a knowledge of the French or German language often aids a designer to keep in touch with the work of European designing rooms through subscribing to and studying French or German Textile Designing publications.

85. This, however, is secondary to securing a thorough knowledge of the manufacturing conditions as they exist in America. A designer should never cease to study and keep in touch with these conditions, from the raw material to the finished fabric, so that he may know the whole of the processes which lead up to the production of the fabric, and he may thus learn how to obtain the most artistic effects in the most economical manner.

The American Correspondence School of Textiles,

EXAMINATION PAPER.

TEXTILE DESIGNING.

DESIGNERS' REQUIREMENTS.

For instructions as to answering these questions, refer to the sheet of rules sent with your first instruction paper.

If definitions are called for, do not use the same words as are given in the lesson.

EXAMINATION QUESTIONS.

1. Explain the process of tying over a sample warp.
2. State the difference between the trial and selling samples, stating the uses or objects of each.
3. (a) If 50 inches of filling from a cotton sample are found to weigh 1 gr., what are the counts?
(b) Suppose the sample is worsted and 50 inches of yarn are found to weigh 1 gr., what are the counts?
4. Suppose that it is desired to reproduce cloth similar to sample E. Show the lay-out sheet for this sample giving every particular, also show two other patterns for this same style, using colors of yarn which you think would be suitable.
5. Explain fully the manner in which the sample warp to give the necessary patterns shown in answer to question 4, would be warped in the designing room.
6. With a trial warp, such as shown in answer to question 4, what changes will be necessary in order to weave the second pattern after the first one is woven?
7. Suppose that this trial warp for sample E contains three patterns, and that each pattern is tied over three times while in the loom. How many regular samples will be obtained?
8. A sample of cloth 2 inches square is found to weigh 5 grains. If cloth similar to this sample is to be made 36 inches wide, what will it weigh per yard?
9. A cloth which is 32 inches wide weighs 5 yards to the pound, and it is decided to make the cloth 36 inches wide. What will be the number of yards to the pound?

10. Show the complete lay-out sheet which would be given if it was desired to reproduce cloth similar to cloth sample K.

11. Show two other patterns for the style similar to sample K, using colors which appear to you to be suitable.

12. Suppose that after weaving the regular patterns made according to the answers given to questions 10 and 11, the pattern which is similar to K is changed by tying over the 4' ends of white with two different colors. State what changes will have to be made to weave this new pattern.

13. A woolen cloth is 66 inches wide in the loom and is finished to 54 inches. What per cent. does the cloth shrink in finishing?

14. A worsted cloth 28 inches wide is to weigh 12 ounces to the yard. What should a trial sample of this cloth 4 inches square weigh? Express your answer in grains.

15. It is desired to make a cotton cloth which shall contain a stripe effect lengthways of the cloth. This stripe effect is to be obtained by having a stripe of plain 1-2 inch wide and then a stripe of satin weave 1-2 inch wide. The satin part is to contain twice as many ends per inch as the plain. A trial sample of this cloth, 12 inches wide is to be woven.

Give the following particulars:

Number of ends in each plain stripe.

" " " " " satin "

" " " " the trial sample.

Counts of the warp. (To be all the same count).

" " " filling. (To be all the same count).

Picks per inch.

Reed to be used.

Number of harnesses to weave the sample.

Harness chain draft.

Drawing-in draft.

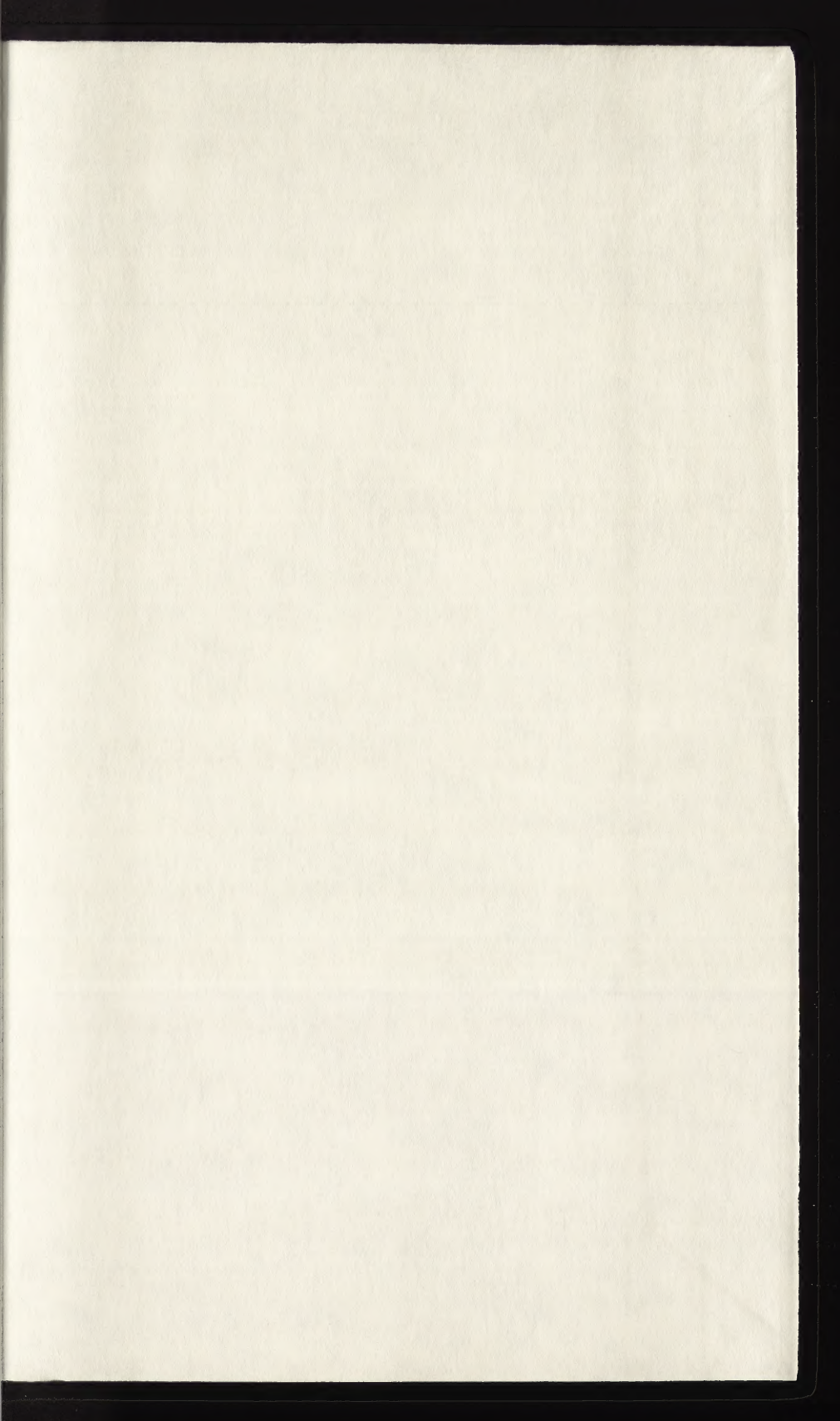
Weight of a sample of this cloth, 6 inches square.

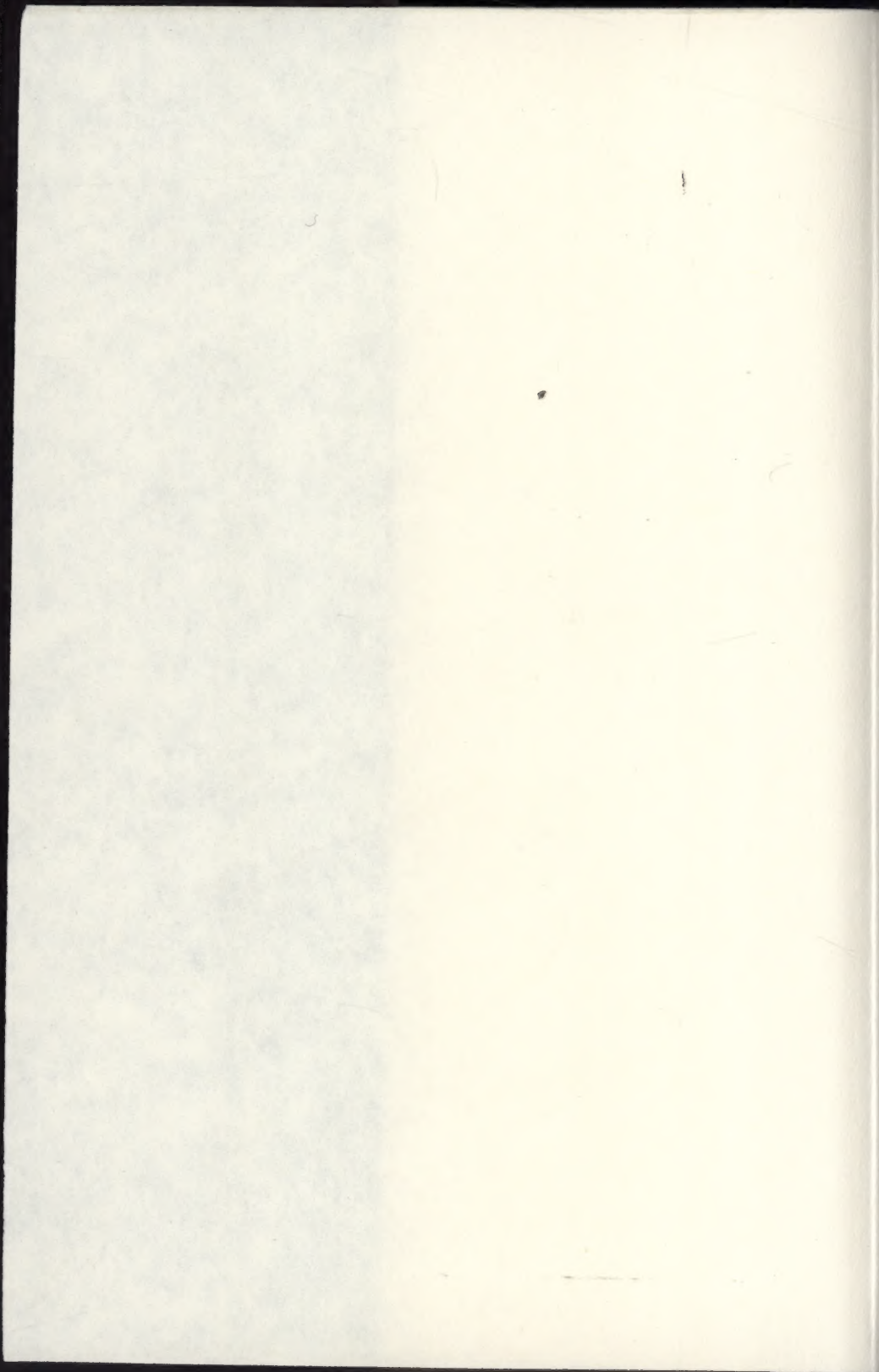
Note. For any item that it is desired to find, and for which no data is given here, the student is to use his own judgment, for instance, the picks per inch, the counts of the filling, etc.

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